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*ADAPTATION IN PATHOLOGICAL PROCESSES.**

GRATEFUL as I am for the personal goodwill manifested by my selection as President of this Congress, I interpret this great and unexpected honor as an expression of your desire to give conspicuous recognition to those branches of medical science not directly concerned with professional practice, and as such I acknowledge it with sincere thanks.

All departments represented in this Congress are working together toward the solution of those great problems—the causes and the nature, the prevention and the cure, of disease—which have always been and must continue to be the ultimate objects of investigation in medicine. It is this unity of purpose which gives to the history of medicine, from its oldest records to the present time, a continuity of interest and of development not possessed in equal degree by any other department of knowledge. It is this same unity of purpose which joins together into a single, effective organism the component groups of this Congress, representing, as they do, that principle of specialization and subdivision of labor which, notwithstanding its perils, has been the great factor in medical progress in modern times.

Medical science is advanced not only by

* Address of the President before the Fourth Triennial Congress of American Physicians and Surgeons, held in Washington, May 4-6, 1897.

those who labor at the bedside, but also by those who in the laboratory devote themselves to the study of the structure and functions of the body in health and disease. It is one of the most gratifying results of the rapid advance in medical education in this country during the last few years that successful workers in the laboratory may now expect some of those substantial rewards which formerly were to be looked for almost exclusively in the fields of practical medicine and surgery. We already have abundant assurance that the steady improvement in opportunities and recompense and other material conditions essential for the prosecution of scientific work in medicine will enable this country to contribute to the progress of the medical sciences a share commensurate with its great resources and development in civilization.

The subject of 'Adaptation in Pathological Processes,' which I have selected for my address on this occasion, is one which possesses the broadest biological, as well as medical, interests. It is this breadth of scientific and practical interest that must justify my choice of a theme which involves many technical considerations and many problems among the most obscure and unsettled in the whole range of biology and of medicine.

I shall employ the epithet 'adaptive' to describe morbid processes which bring about some sort of adjustment to changed conditions due to injury or disease. In view of the more technical and restricted meaning sometimes attached to the term 'adaptation' in biology, objection may be made to this broad and general application of the word in pathology; but no more suitable and convenient epithet than 'adaptive' has occurred to me to designate the entire group of pathological processes whose results tend to the restoration or compensation of damaged structure or function, or to the direct destruction or neutralization of injurious agents. Processes which may be described variously as compensatory, regenerative, self-regulatory, protective, healing, are thus included under adaptive pathological processes. These processes are, in general, more or less advantageous or useful to the individual; but for reasons which will be stated later the conception of pathological adaptation and that of advantage to the individual are not wholly coextensive.

Within the limits of an address I cannot hope to do more than direct attention to some of those aspects of the subject which seem to me to be of special significance. Although most striking examples of adaptation are to be sought in comparative and vegetable pathology, what I shall have to say will relate mostly to human pathology. My purpose is not to point out the beauties or the extent of adaptations in pathological processes, but rather to say something concerning the general mechanism of their production and the proper attitude of mind regarding them, and to illustrate the general principles involved by a few representative examples.

It has been contended that the conception of adaptation has no place in scientific inquiry; that we are justified in asking only by what means a natural phenomenon is brought about, and not what is its meaning or purpose; in other words, that the only question open to scientific investigation is How? and never Why? I hope to make clear by what follows in what light I regard this question, and in this connection I shall simply quote Lotze, who, beginning as a pathologist, became a great philosopher: "Every natural phenomenon may be investigated not only with reference to the mathematical grounds of its possibility and the causes of its occurrence, but also as regards the meaning or idea which it represents in the world of phenomena."

The most wonderful and characteristic attribute of living organisms is their active adaptation to external and internal conditions in such a way as tends to the wel-

fare of the individual or of the species. Of the countless physiological examples which might be cited to illustrate this principle, I select, almost at random, the preservation of the normal temperature of the body in warm-blooded animals under varying external temperatures and varying internal production of heat, the regulation of respiration according to the need of the tissues for oxygen, the influence of the load upon the work performed by muscles, the accommodation of the heart to the work demanded of it, the response of glands to increased functional stimulation, the adjustment of the iris to varying degrees of illumination, the influence of varying static conditions upon the internal architecture of bone.

The most striking characteristic of these countless adaptations is their apparent purposefulness. Even if it be true, as has been said by Lange, that "the formal purposefulness of the world is nothing else than its adaptation to our understanding," it is none the less true that the human mind is so constituted as to desire and seek an explanation of the adaptations which it finds everywhere in organic nature. From the days of Empedocles and of Aristotle up to the present time there have been two leading theories to explain the apparent purposefulness of organic nature—the one, the teleological, and the other, the mechanical theory. The teleological theory, in its traditional signification, implies something in the nature of an intelligence working for a predetermined end. So far as the existing order of nature is concerned, the mechanical theory is the only one open to scientific investigation, and it forms the working hypothesis of most biologists. This theory, in its modern form, seeks an explanation of the adaptations of living beings in factors concerned in organic evolution. What these factors are we know only in part. Those which are most generally recognized as operative are variation, natural selection and heredity. That additional factors, at present little understood, are concerned seems highly probable. The acceptance of the explanation of physiological adaptations furnished by the doctrine of organic evolution helps us, I believe, in the study of pathological adaptations.

As the word 'teleology' has come to have, in the minds of many, so bad a repute in the biological sciences, and as I desire, without entering into any elaborate discussion of the subtle questions here involved, to avoid misconceptions in discussing subjects whose ultimate explanation is at present beyond our ken, I shall here briefly state my opinion that all of those vital manifestations to which are applied such epithets as adaptive, regulatory, regenerative, compensatory, protective, are the necessary results of the action of forms of energy upon living matter. The final result, however useful and purposeful it may be, in no way directly influences the chain of events which leads to its production, and, therefore, the character of the result affords no explanation whatever of the mechanism by which the end, whether it appear purposeful or not, has been accomplished. In every case the ultimate aim of inquiry is a mechanical explanation of the process in question. Notwithstanding valuable contributions, especially within recent years, toward such mechanical explanations, we are still far removed from the attainment of this aim.

The knowledge of the fact that the living body is possessed of means calculated to counteract the effects of injurious agencies which threaten or actually damage its integrity must have existed as long as the knowledge of injury and disease, for the most casual observation teaches that wounds are repaired and diseases are recovered from. It is no part of my present purpose to trace the history of the speculations or even of the development of our

exact knowledge concerning the subjects here under consideration. I cannot refrain, however, from merely referring to the important *rôle* which the conception of disease as in some way conservative or combative in the presence of harmful influences has played from ancient times to the present in the history of medical doctrines. Whole systems of medicine have been founded upon this conception, clothed in varying garb. There is nothing new even in the image, so popular nowadays, representing certain morbid processes as a struggle on the part of forces within the body against the attacks of harmful agents from the outer world. Indeed, Stahl's whole conception of disease was that it represented such a struggle between the anima and noxious agents. What lends especial interest to these theories is that then, as now, they profoundly influenced medical practice and were the origin of such well-known expressions as *vis medicatrix naturæ* and *medicus est minister naturæ*.

It is needless to say that there could be no exact knowledge of the extent of operation or of the nature of processes which restore or compensate damaged structures and functions of the body or combat injurious agents, before accurate information was gained of the organization and workings of the body in health and in disease. Although the way was opened by Harvey's discovery of the circulation of the blood, most of our precise knowledge of these subjects has been obtained during the present century, through clinical observations and pathological and biological studies. In the domain of infectious diseases wonderful and hitherto undreamed-of protective agencies have been revealed by modern bacteriological discoveries. Here, as elsewhere in medicine, the experimental method has been an indispensable instrument for discoveries of the highest importance and for the comprehension of otherwise inexplicable facts. Very interesting and suggestive results, shedding light upon many of the deeper problems concerning the nature and power of response of living organisms to changed conditions, have been obtained in those new fields of experimental research called by Roux the mechanics of development of organisms and also in part designated physiological or experimental morphology. Although we seem to be as far removed as ever from the solution of the most fundamental problem in biology, the origin of the power of living beings to adjust themselves actively to internal and external relations, we have learned something from these investigations as to the parts played respectively by the inherited organization of cells and by changes of internal and external environment in the processes of development, growth and regeneration.

In physiological adaptations, such as those which have been mentioned, the cells respond to changed conditions to meet which they are especially fitted by innate properties, determined, we must believe, in large part by evolutionary factors. In considering pathological adaptations the question at once suggests itself whether the cells possess any similar peculiar fitness to meet the morbid changes concerned; whether, in other words, we may suppose that evolutionary factors have operated in any direct way to secure for the cells of the body properties especially suited to meet pathological emergencies. Can we recognize in adaptive pathological processes any manifestations of cellular properties which we may not suppose the cells to possess for physiological uses? This question appears to me to be of considerable interest. I believe that it can be shown that most pathological adaptations have their foundation in physiological processes or mechanisms. In the case of some of these adaptations, however, we have not sufficiently clear insight into the real nature of the pathological

process nor into all of the physiological properties of the cells concerned to enable us to give a positive answer to the question.

While we must believe that variation and natural selection combined with heredity have been important factors in the development and maintenance of adjustments to normal conditions of environment, it is difficult to see how they could have intervened in any direct way in behalf of most pathological adaptations.

An illustration will make clear the points here involved. Suppose the human race, or any species of animal, to lack the power to compensate the disturbances of the circulation caused by a damaged heart-valve, and that an individual should happen to be born with the exclusive capacity of such compensation. The chances are that there would arise no opportunity for the display of this new capacity, and it is inconceivable that the variety would be perpetuated through the operation of the law of survival of the fittest by natural selection, unless leaky or clogged heart-valves became a common character of the species. When, however, we learn that the disturbance of circulation resulting from disease of the heart-valves is compensated by the performance of increased work on the part of the heart, and that it is a general law that such prolonged extra work leads to growth of muscle, we see at once that this compensation is only an individual instance of the operation of a capacity which has abundant opportunities for exercise in normal life where the influence of natural selection and other factors of evolution can exert their full power.

In a similar light we can regard other compensatory and functional pathological hypertrophies; indeed, I believe, also to a considerable extent the pathological regenerations, inflammation and immunity, although here the underlying factors are, of course, different.

We may, however, reasonably suppose that natural selection may be operative in securing protective adjustments, such as racial immunity, against morbific influences to which living beings are frequently exposed for long periods of time and through many generations.

These considerations help us to explain the marked imperfections of most pathological adaptations as contrasted with the perfection of physiological adjustments, although I would not be understood to imply that the absence of the direct intervention of natural selection in the former is the sole explanation of this difference. The cells are endowed with innate properties especially fitted to secure physiological adaptations. No other weapons than these same cells does the body possess to meet assaults from without, to compensate lesions, to restore damaged and lost parts. But these weapons were not forged to meet the special emergencies of pathological conditions. Evolutionary factors have not in general intervened with any direct reference to their adaptation to these emergencies. Such fitness as these weapons possess for these purposes comes primarily from properties pertaining to their physiological uses. They may be admirably fitted to meet certain pathological conditions, but often they are inadequate. Especially do we miss in pathological adjustments that coordinated fitness so characteristic of physiological adaptations. So true is this that the propriety of using such terms as compensation and adaptation for any results of pathological processes has been questioned.

A heart hypertrophied in consequence of valvular lesion does not completely restore the normal conditions of the circulation. Experience has shown that a kidney hypertrophied in consequence of deficiency of the other kidney is more susceptible to disease than the normal organ. What an incomplete repair of defects is the formation of scar-tissue, and with what inconveniences and even dangers may it be attended in

some situations! If we look upon inflammation as an attempt to repair injury, and, therefore, as an adaptive process, with what imperfections and excesses and disorders and failures is it often associated! How often in some complex pathological process, such as Bright's disease or cirrhosis of the liver, can we detect some adaptive features, attempts at repair or compensation, but these overshadowed by disorganizing and harmful changes!

It is often difficult to disentangle in the complicated processes of disease those elements which we may appropriately regard as adaptive from those which are wholly disorderly and injurious. There are usually two sides to the shield, and one observer from his point of view may see only the side of disorder, and another from a different point of view only that of adaptation.

The conception of adaptation in a pathological process is not wholly covered by that of benefit to the individual. I understand, as has already been said, by an adaptive pathological process one which in its results brings about some sort of adjustment to changed conditions, due to injury or disease. This adjustment is usually, wholly or in part, advantageous to the individual; but it is not necessarily so, and it may be harmful. The closure of pathological defects by new growths of tissue is a process which must be regarded as adaptive. But one would hardly describe as advantageous the scar in the brain which causes epilepsy. A new growth of bone to fill in defects is often highly beneficial; but what grave consequences may result from thickening of the skull to help fill the space left by partial arrest in development of the brain in embryonic life or infancy! We see here, as everywhere, that "Nature is neither kind nor cruel, but simply obedient to law, and, therefore, consistent."

In turning now to the more special, but necessarily fragmentary, consideration of a few of the pathological processes in which adaptation, in the sense defined, is more or less apparent, I shall have in view the answers to those two questions, What is the meaning of the process? and How is it caused? which confront us in our investigation of all natural phenomena. At the outset it must be admitted that our insight into the nature of many of these processes is very imperfect, and that here answers to the world-old riddles Why? and How? are correspondingly incomplete and liable to err.

Although almost all of the elementary morbid processes, even the degenerations and death of cells, may, under certain conditions of the body, serve a useful purpose, the preeminent examples of pathological adaptation, in the sense of restoration or compensation of damaged structure or function, or the direct destruction or neutralization of injurious agents, are to be found among the compensatory hypertrophies, the regenerations and the protective processes. To this last ill-defined group I refer parasiticidal and antitoxic phenomena, and some of the manifestations of inflammation, and perhaps also of fever. In the last analysis these protective processes, no less than the others mentioned, must depend upon the activities of cells.

As it is manifestly impossible within the limits of a general address to attempt a detailed consideration of any large number of these adaptive pathological processes, and as such consideration would necessarily involve the discussion of many technical and doubtful points, I have thought that my purpose would be best served by the selection of a few representative examples.

The compensatory hypertrophies afford admirable illustrations of certain fundamental principles regarding adaptations in pathology which I have already stated. The hypertrophy secures a functional adjustment, often of a highly beneficial character, to certain morbid conditions. This useful purpose is attained by a succession of

events determined from beginning to end by the necessary response of cells and tissues, in consequence of their inherent organization, to the changed conditions. Given the changed conditions on the one hand, and the organization of the cells on the other, the result must follow as surely as night follows day, and this final result influences the preceding series of events no more in the one case than in the other. That the cells possess the particular organization determining the manner of their response to these changed conditions, and, therefore, the beneficial character of the result, is dependent upon innate properties whose fitness for the purpose doubtless has been largely fixed by evolutionary factors, operating, however, mainly in behalf of physiological functions and not directly toward pathological adjustments. In correspondence with this view we find that our knowledge of the manner of production of the compensatory hypertrophies of various organs and tissues stands in direct relation to our knowledge of the physiology of the same organs and tissues.

Those compensatory hypertrophies into the mechanism of whose production we have the clearest insight are referable to increased functional activity, and are, therefore, spoken of as work-hypertrophies. This has been proved for the muscular hypertrophies and compensatory hypertrophy of the kidney, but the demonstration is not equally conclusive for the compensatory hypertrophy of other glands. I know, however, of no instance in which this factor in the explanation can be positively excluded.

The relationship between increased functional activity and hypertrophy is so evident in many cases that there is strong presumption in favor of this explanation of those glandular compensatory hypertrophies which have not as yet been clearly referred to the class of functional hypertrophies. The very occurrence of compensatory hypertrophy of an organ may direct attention to the fact that it is endowed with definite functions, and the conditions under which the hypertrophy occurs may shed light upon the nature of these functions. I need only remind you of the significance, from this point of view, of the compensatory hypertrophy of the thyroid, adrenal, pituitary, and other glands with internal secretions. I fail to see why Nothnagel should consider *a priori* improbable the occurrence of compensatory hypertrophy of one sexual gland after loss of the other, even before sexual maturity, or why Ribbert, who has apparently demonstrated experimentally such an occurrence, should find it necessary to seek the explanation in reflex nervous influences or mere hyperæmia. The so-called secondary sexual characters and the changes following castration, including the influence upon a hypertrophied prostate, point to important, even if little understood, functions which for the present we can, perhaps, best attribute to so-called internal secretions of these sexual organs.

The name compensatory hypertrophy is sometimes applied to growths of tissue that merely take the place of another kind of tissue which has fallen out, as, for example, the growth of adipose tissue around a shrunken kidney or pancreas, or between atrophied muscle-fibres. Here there is only compensation of space, but no compensation of structure or function. Such hypertrophies and growths are described better as complementary than compensatory.

Familiar examples of pathological hypertrophies from increased work are the hypertrophy of the heart from valvular disease and other causes, that of the muscular coats of canals and bladders behind some obstruction, and that of one kidney after loss or atrophy of the other.

In order to understand fully the manner of production of work-hypertrophy of a part, resulting from some morbid condition, it is

essential to know the nature of the disturbances induced by the underlying morbid condition, how these disturbances excite increased functional activity of the part which becomes hypertrophied, and what the relationship is between this greater activity and the increased growth of the part.

It is impossible on this occasion to go through the whole list of compensatory hypertrophies with reference to the application of these principles. In no instance can the requirements stated be completely met in the present state of our knowledge. It will suffice for an understanding of the principles involved, and it is only with these that I am now concerned, if I take a concrete example. I select the classical and best studied one—compensatory hypertrophy of the heart. I trust that I shall be pardoned for selecting so commonplace an illustration, as the main points involved must be familiar to most of my audience; but it is possible that the application made of them may not be equally familiar. The only matters essential to my present line of argument are the mechanism of production of the hypertrophy and the general character of the adaptation thereby secured.

The heart, like other organs of the body, does not work ordinarily up to its full capacity, but it is capable of doing at least three or four times its usual work. The excess of energy brought into play in doing this extra work is called conveniently, although not without some impropriety, 'reserve force.' It has been proved experimentally that this storehouse of reserve power is sufficient to enable the healthy heart, at least that of a dog, to accommodate itself at once or after a few beats to high degrees of insufficiency or obstruction at its valvular orifices without alteration in the mean pressure and speed of the blood in the arteries. But even so tireless and accommodating an organ as the heart cannot be driven at such high pressure without sooner or later becoming fatigued, and consequently so dilated as to fail to meet the demands upon it. If it is to continue long the extra work, it must receive new increments of energy.

The cardiac muscle is far less susceptible to fatigue than the skeletal muscles, but that it may become fatigued seems to me clear.

Leaving out of consideration some doubtful causes of cardiac hypertrophy, such as nervous influences, the various morbid conditions which lead to this affection are such as increase either the volume of blood to be expelled with each stroke or the resistance to blood-flow caused by the pressure in the arteries or by narrowing at one of the valvular orifices, or both. Unless some regulating mechanism steps in, each of these circulatory disturbances must increase the resistance to contraction of the cardiac muscle, and it is evident that the heart must do extra work if it is to pump the blood through the arteries with normal pressure and speed. It is, however, no explanation of this extra work simply to say that it occurs because there is demand for it. Increased work by the heart in cases of disease of its nutrient arteries would often meet a most urgent demand on the part of the body, but here the heart flags and fails.

The physiologists have given us at least some insight into the mechanism by which the heart responds through increased work to the circulatory disturbances which have been mentioned. These disturbances all increase the strain on the wall of one or more of the cavities of the heart; in other words, increase the tension of the cardiac muscle, in much the same way as a weight augments the tension of a voluntary muscle. Now it is a fundamental physiological law that with a given stimulus greater tension of a muscle, within limits, excites to more powerful contraction, and thus to the per-

formance of greater work. It seems clear that this law applies to the muscle of the heart, as well as to voluntary muscle. We do not know precisely how increased tension facilitates the expenditure of greater muscular energy.

Another well-known fact in the mechanics of muscle is of importance in this connection. With increase of muscular tension under a given stimulus, a point is reached where the extent of contraction is diminished, although the mechanical work done, determined by multiplying the height to which the load is lifted by the weight of the load, is increased. This law applied to the heart, whose contractions are always maximal for the conditions present at any given time, signifies that, with increased resistance to the contraction of the muscular wall of one of its cavities, this cavity will empty itself during systole less completely than before. In other words, dilatation occurs, and, as has been shown by Roy and Adami, to whom we owe important contributions on this as well as on many other points relating to the mechanics of the heart, dilatation regularly antedates hypertrophy. This primary dilatation, however, is not to be looked upon as evidence of beginning heart failure, for, as these investigators pointed out, it is within limits only an exaggeration of a physiological condition, and can be subsequently overcome by hypertrophy which, in consequence of increase in the sectional area of the muscle, lessens the strain upon each fibre, and thereby permits it to shorten more during contraction. If this result is completely secured we have simple hypertrophy. More often the dilatation remains, and must necessarily remain, and we have excentric hypertrophy, which secures, for a time at least, adequate, but I do not think we can say perfect, compensation.

The weight of existing evidence favors the view that the power of the heart to adapt its work to the resistance offered resides primarily in its muscle-cells, and not in intrinsic or extrinsic nervous mechanisms, although doubtless these latter in various ways, which cannot be here considered, influence and support this regulating capacity. Nor can I here pause to discuss the influence of blood-supply to the cardiac muscle upon the force of ventricular contraction, although Porter has demonstrated that this is important.

In tracing the steps from the primary morbid condition to the final hypertrophy, we have thus far had to deal mostly with known mechanical factors. We now come to the question, How does increased functional activity lead to increased growth?

Inasmuch as greater functional activity is regularly associated with a larger supply of blood to the more active part, the view is advocated by many that the increased growth is the direct result of this hyperæmia, and one often encounters, especially in biological literature, this opinion expressed as if it were an indisputable fact. There is, however, no conclusive proof of this doctrine, and many facts speak against it. The examples from human pathology commonly cited to support the doctrine that local active hyperæmia incites growth of cells are, so far as I am able to judge, complicated with other factors, such as injury, inflammation or trophic disturbances. Transplantation-experiments, such as John Hunter's grafting the cock's spur upon the cock's comb, sometimes adduced in this connection, are not decisive of this question, for here a new circumstance is introduced which some suppose to be the determining one for all morbid cell-growth, namely, the disturbance of the normal equilibrium between parts. Local active hyperæmia may exist for a long time without evidence of increased growth in the congested part. To say that the hyperæmia must be functional is at once to concede that it is not

the sole factor. Experiments from Bizzozero's laboratory, by Morpurgo and by Penzo, indicate that local hyperæmia due to vasomotor paralysis, or to the application of heat, favors cell multiplication in parts where proliferation of cells is a normal phenomenon, or is present from pathological causes, but that it is incapable of stimulating to growth cells whose proliferating power is suspended under physiological conditions, as in developed connective tissue, muscles and the kidneys.

It has been usually assumed that the way in which local hyperæmia may stimulate cell-growth is by increasing the supply of nutriment to cells. The trend of physiological investigation, however, indicates that the cell, to a large extent, regulates its own metabolism. If the cell needs more food, of course, it cannot get it unless the supply is at hand, and in this sense we can understand how a larger supply of blood may be essential to increased growth, but this is a very different thing from saying that the augmented blood-supply causes the growth.

It is by no means clear that the question as to the influence of increased blood-supply upon cell-growth is identical with that of increased lymph-supply. The experiments of Paschutin and of Emminghaus, from Ludwig's laboratory, nearly a quarter of a century ago, indicate that local hyperæmia due to vasomotor paralysis does not, as a rule, increase the production of lymph; and more recent experiments, although not wholly concordant in their results upon this point, tend to the same conclusion. Functional activity, however, has a marked influence in increasing the quantity and affecting the quality of lymph in the active part. Our knowledge of the physical and chemical changes in working muscles and glands enables us to conceive why this should be so, for all are now agreed that the formation of lymph is due not simply to filtration from the blood-plasma, but also to diffusion, and some believe likewise to active secretion by the capillary endothelium. Doubtless arterial hyperæmia is essential to the maintenance of the increased flow of lymph in working organs.

There are difficulties in the way of supposing that increased supply of lymph in itself furnishes the explanation of cell-growth, and especially of that which characterizes hypertrophy of muscles and glands. Pathologists have frequent opportunities to study the effects of all degrees of increased production and circulation of lymph associated with venous hyperæmia. A kidney or a muscle may from this cause be subjected for months and years to an excess of lymph-flow, but there is no demonstration of any consequent hypertrophy or hyperplasia of renal epithelium or muscle-cell. It is true that the chemical composition of the lymph is not the same as that of lymph resulting from increased function, and it is possible that in this chemical difference lies the kernel of the whole matter. It may also be urged that in venous hyperæmia there are circumstances which restrain or prevent growth. Nevertheless, if overfeeding, merely in consequence of increased supply of nutriment, were the real explanation of work-hypertrophies, one would expect to find some evidence of this in the class of cases mentioned.

Ribbert has recently given a new shape to the doctrine that local hyperæmia excites growth. While rejecting the usual explanation that it does so by supplying more food, he contends that distention of the bloodvessels and lymph-spaces, by mechanically disturbing the mutual relations of parts, removes obstacles to growth. This theory cannot be advantageously discussed until the fact is first established that uncomplicated local hyperæmia does incite growth.

As the matter now stands, it seems to me that any satisfactory explanation of the cell-growth causing work-hypertrophies must start from physical or chemical changes in the muscle- or gland-cell itself directly connected with the increased function. These changes are the *primum mobile*, and, however important increased supply of blood or lymph may be in the subsequent chain of events, it is not the determining factor. The whole problem is part of the general one of the causes of pathological cell-growth, to which I shall have occasion to refer again.

It is interesting to note that not all kinds of excess of functional activity lead to hypertrophy. A heart may beat for years faster than normal without becoming hypertrophied. Small movements of muscle, often repeated, do not cause hypertrophy. It would appear that the amount of work done in each functional act must attain a certain height in order to stimulate growth. On the other hand, if the muscle be stretched beyond certain limits, it does not hypertrophy; on the contrary, it may atrophy, as may be seen in greatly distended canals and cavities with muscular walls. This behavior is also in accordance with physiological observations.

The compensatory hypertrophy of muscle seems to be due mainly to increase in the size of cells, although there are observations indicating that they may also multiply. That of most glands is referable to increase both in number and size of cells. Within four or five days after extirpation of a kidney, karyokinetic figures may be found in increased number in the cells of the remaining kidney.

The general character of the adaptation secured by compensatory hypertrophy of the heart is sufficiently well known. I wish to point out certain of its imperfections. I shall not dwell upon the well-known abnormal conditions, with their remote consequences, of the systemic or pulmonary circulation, which are present during the stage of compensation, nor shall I speak of the various circumstances which may interfere with the establishment of compensatory hypertrophy.

The muscle of a hypertrophied heart is sometimes compared to that of the blacksmith's arm, and the statement is made that there is no reason inherent in the muscle itself why the one should fail more than the other. This may be true, but it is not self-evident. Exercise may influence in various ways the nutrition, function and growth of muscle as well as of other parts. Mere increase in bulk is a coarse effect. Quality may be improved as well as quantity. The biggest muscle is not necessarily the best or the most powerful. As every trainer knows, various conditions under which work is done influence the result. Increase in the reserve energy of the heart, secured by judicious exercise—and this is the main factor in endurance—probably cannot be attributed mainly to hypertrophy; indeed, enlargement of this organ from exercise is often a serious condition. Much more might be said in this line of thought, but I have indicated why it seems to me unjustifiable to assume, without further evidence, that the condition of the muscle in pathological hypertrophies is necessarily identical in all respects with that in physiological hypertrophies.

There is an important difference in the working conditions between most hypertrophied hearts and the normal heart. Although the maximal available energy of a hypertrophied heart during compensation is greater than that of the normal heart, clinical experience shows that in the majority of cases the energy available for unusual demands—that is, the so-called reserve force—is less in the former than in the latter. Sometimes, especially when the hypertrophy has developed in early life, the

hypertrophied heart is at no disadvantage in this respect. As pointed out with especial clearness by Martius, the significance of this alteration in the ratio normally existing between the energy expended for ordinary needs and that available for unusual demands is that it furnishes an explanation of the greater liability of the hypertrophied heart to tire upon exertion. Fatigue of the heart is manifested by dilatation of its cavities, and when this dilatation from fatigue is added to that already existing in most cases, relative insufficiency of the mitral or tricuspid valve is likely to occur, and the compensation is, at least for a time, disturbed. The circulation through the coronary arteries, whose integrity is so important for the welfare of the heart, is impaired, and a vicious circle may be established. Notwithstanding the valuable contributions from the Leipzig clinic as to the frequency of various anatomical lesions in the muscles of hypertrophied hearts, it does not seem to me necessary to have recourse to them as an indispensable factor in the explanation of the breakage of compensation; but I shall not here enter into a discussion of the general subject of the causes of failure of compensation.

I have described, with some detail, although very inadequately, the manner of production of compensatory hypertrophy of the heart, in order, by this representative example, to make clear what seem to me to be certain general characteristics of many adaptive pathological processes, and I beg here to call attention especially to the following points. As has been emphasized by Nothnagel and others, no teleological idea or form of language need enter into the explanation of the mechanism of the process. The final result is the necessary consequence of the underlying morbid conditions. We have satisfactory mechanical explanations for essential steps in the process, and there is no reason to assume that other than mechanical factors are concerned in those vital manifestations which at present we are unable to explain by known physical and chemical forces. The properties of the cells which determine the character of their response to the changed conditions are none other than their well-known physiological properties. The adaptation finally secured, admirable as it is in many respects, and perhaps adequate for a long and active life, is generally attended with marked imperfections, and, strictly speaking, is not a complete compensation. It does not present that coordinate and special fitness which we are accustomed to find in physiological adaptations, for the explanation of which so much has been gained by the study of the factors concerned in organic evolution.

It may be argued that under the circumstances no better kind or degree of adaptation can be conceived of than that which actually occurs, and that the operation of evolutionary factors, with special reference to the adjustment of the organism to the conditions causing cardiac hypertrophy, could not secure any better result. I think that it is not difficult to conceive how improvements might be introduced. It is, however, permissible to suppose that the introduction into the workings of the organism of some better mechanism to compensate the morbid conditions might be at the sacrifice of more important physiological attributes of the body. More perfect pathological adaptations might in many instances involve a deterioration of the physiological characters of the species. It is often the case that the more highly organized living beings lack some capacity possessed by those lower in the scale of organization to resist or compensate injury and disease. This is notably true of the power to regenerate lost parts. It is, however, along the lines of improvement in the physiological characters of the individual or species that the opportunity often lies

for securing increased resistance to disease or better pathological adaptations.

It would be interesting to continue our consideration of the compensatory hypertrophies by an examination of those of glandular organs from points of view similar to those adopted for the heart. For the kidney, at least, the materials are at hand for such a purpose, but, as I desire in the limited time at my disposal to touch upon other varieties of pathological adaptation, I must refer those interested especially to the investigations of Grawitz and Israel, Ribbert, Nothnagel and Sacerdotti as to the conditions underlying compensatory hypertrophy of the kidney. I can likewise merely call attention to the interesting researches of Ponfick upon the most wonderful of the compensatory hypertrophies in higher animals, that of the liver. Ponfick, as is well known, has demonstrated that, after removal of three-fourths of this organ, new liver-substance, with normal functions, is recreated from the remainder and to an amount nearly equalling that which was lost.

The chapter of pathological adaptations in bones and joints I shall leave untouched, notwithstanding the admirable illustrations which might be drawn from this domain.

There is no more fascinating field for the study of pathological adaptations with reference to the mechanical factors involved than that furnished by the blood-vessels, as has been shown especially by the brilliant researches of Thoma. With wonderful precision can a vessel or system of vessels adjust itself to changes in the pressure, velocity and quantity of blood, and thereby serve the needs of the tissues for blood. Under pathological, as well as physiological, conditions this adjustment may be brought about not only through the agency of vasomotor nerves and the physical properties of the vascular wall, but also, when the necessity arises, by changes in the structure of the wall.

The changes in the circulation introduced by the falling-out of the placental system at birth are essentially the same as those resulting from amputation of an extremity, and the consequent alterations in the structure of the umbilical artery are identical with those in the main artery of the stump after amputation. The closure of the ductus Botalli and the ductus venosus soon after birth, and, still better, transformations of vessels in the embryo, furnish physiological paradigms for the development of a collateral circulation. Many other illustrations might be cited, did time permit, to show that in the processes of normal development, growth and regressive metamorphosis of parts, both before and after birth, and in menstruation and pregnancy, changed conditions of the circulation arise analogous to certain ones observed under pathological circumstances, and that the mode of adjustment to these changes by means of anatomical alterations in the vessels may be essentially the same in the physiological as in the morbid state. I see in these facts an explanation of the relative perfection of certain vascular adaptations to pathological or artificial states, as may be exemplified by changes in a ligated artery and by the development of a collateral circulation. The mechanisms by which the adjustments are secured have, in consequence of their physiological uses, for reasons already explained, a special fitness to meet certain pathological conditions. That this fitness should be greater in youth than in old age is in accordance with laws of life, indicated with especial clearness by Minot in his interesting studies on 'Senescence and Rejuvenation.'

But these mechanisms are not equally well adapted to meet all morbid changes in the vessels. Although Thoma's interpretation of the fibrous thickening of the inner lining of vessels in arterio-sclerosis and aneurism, as compensatory, or, as I should

prefer to say, adaptive, is not accepted by all pathologists, it seems to me the best explanation in many cases. But the adaptation, if it be such, is here usually of a very imperfect nature, and it is not surprising that it should be so, when one considers the improbability of any mechanism developing under physiological conditions which should be specially fitted to meet the particular morbid changes underlying aneurism and arterio-sclerosis.

I shall not be able to enter into a consideration of the mechanical factors concerned in adaptive pathological processes in blood-vessels, although perhaps in no other field are to be found more pertinent illustrations of the views here advocated concerning pathological adaptations. The whole subject has been studied from the mechanical side most fully and ably by Thoma, whose four beautifully simple histo-mechanical principles are at any rate very suggestive and helpful working hypotheses, even if it should prove, as seems to me probable, that they are too exclusive. I shall call attention in this connection only to the inadequacy of the old and still often adopted explanation of the development of a collateral circulation. The rapidity with which a collateral circulation may be established after ligation of a large artery, even when the anastomosing branches are very small, is known to every surgeon. This was formerly attributed to increase of blood pressure above the ligature, but this rise of pressure has been shown to be too small to furnish a satisfactory explanation, and Nothnagel has demonstrated that there is little or no change in the calibre of arteries coming off close above the ligature unless they communicate with branches arising below the ligature. Von Recklinghausen several years ago suggested a better explanation. The bed of the capillary stream for the anastomosing arteries is widened by ligation of the main artery, inasmuch as the blood can now flow with little resistance from the capillaries of the anastomosing branches into those of the ligated artery. The result is increased rapidity of blood-flow in the anastomosing vessels. According to one of Thoma's histo-mechanical principles, increased velocity of the blood current results in increased growth of the vessel wall in superficies—that is, in widening the lumen. The tension of the vessel wall, which is dependent on the diameter of the vessel and the blood pressure, is, according to Thoma, thus increased; and, according to another of his principles, this greater tension results in growth of the vascular wall in thickness. The changes in the walls of the anastomosing vessels seem to me to be best interpreted as referable to a genuine work hypertrophy, a conception which has already been advanced by Ziegler.

The pathological regenerations constitute a large group of adaptive morbid processes of the highest interest. Their study has become almost a specialized department of biology, and occupies a very prominent place in the extensive literature of recent years relating to experimental or physiological morphology. It has revealed, in unexpected ways, the influence of external environment upon the activities of cells, as is illustrated in a very striking manner by Loeb's studies of heteromorphosis.

Although the capacity to regenerate lost parts must reside in the inherited organization of the participating cells, there are observations which seem to indicate that in the lower animals this capacity may exist independently of any opportunity for its exercise during any period of the normal life of the individual or species or their ancestors, including the period of embryonic development. This is the inference which has been drawn from Wolff's observation, that after complete extirpation of the ocular lens with the capsular epithelium in the larval salamander a new lens is reproduced

from the posterior epithelium of the iris. There are other observations of similar purport. The acceptance of this inference, however, seems to me to involve such difficulties that we may reasonably expect that further investigations will afford more satisfactory explanations of these curious and puzzling phenomena of regeneration. Of much interest and significance are the so-called atavistic regenerations, where the regenerated part assumes characters belonging not to the variety or species in which it occurs, but to some ancestral or allied species. For these and other reasons Driesch refers the pathological regenerations to what he calls the secondary self-regulations, by which term he designates those adjustments of artificially induced disturbances which are brought about by factors foreign to the normal development and life of the individual.

The view advocated by Barfurth seems to me more probable, that the pathological regenerations depend upon cellular properties pertaining to the normal life of the organism. This view is supported by the fact that, with a few probably only apparent exceptions, the regenerations conform to the law of specificity of cells. The pathological regenerations occurring after birth can be referred to the retention, in greater or less degree, of formative powers possessed by the cells preeminently in embryonic life. These powers in general tend gradually to diminution or extinction as the individual grows older, although in some cells, such as the covering epithelium of the skin and mucous membranes, this loss of regenerative power with advancing years is scarcely manifest. Even after the cessation of growth the regenerative capacity is not wholly in abeyance under physiological conditions. Bizzozero has studied and classified the various tissues of the body according to the activity of their physiological regeneration.

In general, the more highly differentiated and specialized a cell, the less is its capacity for regeneration; but we now know that such differentiation is attended with less sacrifice of its regenerative power than was once supposed. Even such highly specialized cells as those of striped muscle are capable of regeneration. Indeed, in higher animals the nerve-cells seem to be the only ones incapable of proliferation, and even this is not certain, for there are competent observers who claim that these cells may multiply, although there is no evidence that in the higher animals they can give rise to functionally active new nerve-cells. The ease with which a part of the nerve-cell, namely, its axis-cylinder process, can be regenerated is well known.

The cell-proliferation in regeneration is attributed to the removal of resistance to growth in consequence of the defect resulting from loss of tissue. It has been pointed out, especially by Ziegler and by Ribbert, that not only cells in the immediate neighborhood of the defect multiply, but likewise those at such a distance that it is difficult to suppose that the latter have been directly influenced by the loss of tension in the tissues caused by the defect. Ziegler refers the proliferation of the distant cells to compensatory hypertrophy, and Ribbert attributes it to hyperæmia resulting from the presence in the defect of foreign materials, such as extravasated blood, exudation and necrotic tissue.

We are brought here, as we were in the consideration of the compensatory hypertrophies, to one of the most fundamental and important questions in pathology—the causes of pathological cell-growth. The interpretation of many pathological processes as adaptive or not hinges often upon opinions held concerning the underlying causes of cell-proliferation. The main question at issue is, How far is one willing to go in attributing cell-growth to primary

defects in the tissues, and in interpreting the growth as for the purpose of regeneration or filling up a defect? Differences of opinion upon this subject are illustrated by the different interpretations of the cell-proliferations in acute and chronic inflammations; some pathologists considering these to be essentially regenerative and compensatory; others regarding them, at least in large part, as directly incited by inflammatory irritants and not to be ranked wholly with the regenerative processes.

The doctrine of Virchow was long accepted without question, that inflammatory cell-growth is the result of the action of external stimuli, the so-called inflammatory irritants, upon the cells, which are thereby directly incited to grow and multiply. The attack upon this doctrine has been led most vigorously by Weigert, who denies absolutely the power of any external agencies to stimulate directly cells to proliferation. He considers that to concede such a bioplastic power to external agents is equivalent to the acceptance of a kind of spontaneous generation of living matter.

Weigert's views upon this subject have had undoubtedly a most fruitful influence upon pathology. It has been such an influence as a good working hypothesis, whether finally demonstrated to be true or not, has often had in the development of science. In putting to the test of actual observation Weigert's hypothesis we have been led to recognize the frequency and the importance of primary injuries to cells inflicted by external agencies. Not only various degenerations and necroses of entire cells, but more subtle and partial damage of cytoplasm and nucleus, have been made the subject of special study. It has been recognized that our older methods of hardening tissues reveal often only very imperfectly the finer structure of cells, and new and better methods have been introduced which enable us to detect more delicate lesions of cell-substance which formerly escaped attention, as is well illustrated in recent studies in neuropathology. Weigert's postulate of some primary injury to the tissues as the immediate effect of mechanical, chemical and other external agencies, which were formerly regarded as the direct stimuli of cell-growth and multiplication, has been fulfilled in many instances where such damage had previously been overlooked or unsuspected. It is his belief that in cases where we cannot now detect such primary injury more thorough search and better methods will enable us to do so. One may, of course, reasonably cherish such an expectation; but at the same time we must recognize the fact that morbid cell-proliferations occur under circumstances where we cannot at present associate them with any demonstrable primary injury to the tissues—indeed, in some cases where our insight into the structure of the part seems to be so clear and satisfactory that one is very reluctant to admit the existence of an undetected damage to the cells.

Perhaps the most important modification of former pathological conceptions, resulting from the belief that cell-growth is caused by primary defects and injuries of tissue, relates to the chronic interstitial inflammations or fibroid processes. The older view that in these processes the active and essential feature of the disease is the new growth of connective tissue, which strangles the more highly organized cells of the part, has been replaced to a large extent by the opinion that the primary and most important lesion is the degeneration, atrophy or necrosis of the more specialized cells, whose place is taken by the new growth of interstitial tissue. In many instances, as in fibroid patches in the myocardium, and in many scleroses of the central nervous system, this latter conception affords the best and most natural interpretation of the facts.

There are, however, great difficulties in explaining all chronic interstitial inflammations by this doctrine, and I must take side with those who admit the occurrence, for example in the kidney and in the liver, of primary interstitial inflammations characterized by proliferation of the connective tissue and endothelial cells.

Indeed, it seems to me that Weigert's formula is too narrow to cover all of the observed facts concerning cell-proliferation. Essential features of the theory that cells cannot be directly stimulated to growth by external agents were present in Boll's doctrine of border warfare between neighboring cells. Weigert's presentation of this theory is in a far more acceptable shape than that of Boll. A still more comprehensive statement of the general theory is that cells are incited to growth through removal of obstacles to growth in consequence of some disturbance in the normal relations or equilibrium of the cells with surrounding parts. The capacity to proliferate must be present in the cells, but with the cessation of growth this capacity is rendered latent or potential by the establishment of definite relations or an equilibrium between cells and neighboring parts, including under the latter not only adjacent cells, but also basement-substance, lymphatics, bloodvessels, tissue-juices, chemical substances, etc. It is evident that under these circumstances in only two ways can the cells be incited to growth, either by removal of resistance or obstacles to growth, or by an increase in the formative energy resident within the cell, and that in either way energy must be used, whether it be employed to remove obstacles to growth or to increase the proliferative forces within the cell.

It appears to me by no means an easy matter to decide in all cases in which of the two ways mentioned cell-proliferation is brought about. Removal of obstacles to growth, not only in the way indicated by Weigert, but also by other disturbances in the neighborhood relations of the part, and very probably by the presence of definite chemical substances, may be the explanation of all pathological cell-growths. Certainly it would not be easy conclusively to disprove this view. Nevertheless, I fail to comprehend the inherent difficulties which some find in admitting the possibility of forms of energy, acting from without, directly increasing the formative energy of the cell; in other words, directly stimulating the cell to growth and multiplication. If such a possibility be admitted, the natural interpretation of some examples of cell-proliferation is that they are directly caused by the action of external forces, in the sense advocated by Virchow.

Students of the problems of pathological cell-growth must take into consideration not only the facts of human and allied pathology, but also those which are so rapidly accumulating in the domain of experimental embryology and morphology, to the importance of which I have repeatedly referred in this address. I would call attention especially to the observations from this source as to the influence of various changes of environment, particularly of definite chemical, thermic and mechanical changes in surrounding parts, upon the direction of movement and growth of cells. The use at present made of chemotactic phenomena in explaining the direction of movement of cells in human pathological processes is only a very limited and inadequate application of these important observations concerning tactic and tropic stimuli. We shall come to realize more and more the operation of these factors in determining cell-movements and cell-growth in human pathology. We already have evidence that different kinds of leucocytes not only possess different specific functions, but also respond in different ways to definite tactic stimuli. The long-standing problem

of the lymphoid cell in inflammation approaches solution along these lines of investigation.

A burning question, and one of perennial interest, relating to our subject is: How far are we justified in regarding acute inflammation as an adaptive or protective morbid process? There is fair agreement as to the essential facts of observation, but regarding their interpretation there are wide differences of opinion, and when one considers the complexity of the process and its still unsolved riddles it is not hard to see why this should be so. Much depends upon the point of view, and in this respect there can be recognized a certain antagonism between the purely clinical and the purely pathological and experimental views, an antagonism, however, which must be reconciled by a full knowledge of the subject.

It is not likely that the purely clinical study of inflammation would ever lead to the idea that the general tendency of this process is advantageous to the patient. The more severe and extensive the inflammatory affection, the more serious, as a rule, is the condition of the patient. The surgeon sees his wounds do well or ill, according to the character and extent of inflammatory complication. Measures directed to the removal of inflammatory exudation, such as the evacuation of pus from an abscess or an empyema, are the most successful methods of treatment, and their rules are embodied in ancient surgical maxims. How can one conceive of any purpose useful to the patient served by filling the air-cells of his lungs with pus-cells, fibrin and red corpuscles in pneumonia, or bathing the brain and spinal cord in serum and pus in meningitis? If nature has no better weapons than these to fight the pneumococcus or meningococcus, it may be asked, "What is their use but to drive the devil out with Beelzebub?"

But the pathologist and bacteriologist sees another aspect of the picture. An infectious micro-organism has invaded the tissues, where it multiplies and where its toxic products begin to work havoc with the surrounding cells, and by their absorption to cause constitutional symptoms and perhaps damage to remote parts. Is the destructive process to go on without any defense on the part of the body? There are attracted to the injured part an army of leucocytes from the bloodvessels, and perhaps other cells from the neighboring tissues, and it has been conclusively shown that these cells can pick up foreign particles and remove them, and that they contain substances capable of destroying many micro-organisms. At the same time serum accumulates in and around the injured area, and this may aid in destroying bacteria by its chemical properties, in diluting poisons, in flushing out the part. Fibrin may appear, and some think that this may serve in some situations as a protective covering. If these agencies, hostile to the invading micro-organisms, gain the upper hand, the débris is cleared away by phagocytes and other means, and the surrounding intact cells, which had already begun to multiply, produce new tissue which takes the place of that which had been destroyed. The victory, however, is not always with the cells and other defensive weapons of the body. The struggle may be prolonged, may be most unequal, may cover a large territory, and the characters and the extent of the inflammation furnish an index of these different phases of the battle.

Such in bald outlines are two divergent views of acute inflammation.

I do not see how we can fail to recognize in that response to injury, which we call inflammation, features of adaptation. Inflammation may be in some cases the best response to secure the removal or destruc-

tion of injurious agents, but we cannot look upon it as the most perfect mode of protection of the body against invading micro-organisms. One may inoculate into three animals, even of the same species, but possessed of different individual resistance, the same quantity of the same culture of a pathogenic micro-organism and obtain sometimes the following results: The first one will present no appreciable inflammatory reaction whatever and no evidences of any other disturbance, and examination will show that the micro-organisms have quickly disappeared. The second one will develop an extensive local inflammation and survive, but after a long illness. The third one will offer little resistance to the micro-organism, which rapidly multiplies without causing marked inflammation, invades the blood or produces toxæmia, and quickly destroys the life of the animal. Now, it is evident that the best protective mechanism is that brought into action by the first animal, but that the inflammatory reaction set up in the second one is better than the absence of reaction and of other defenses in the third animal.

I can scarcely do more on this occasion than to indicate some of the points of view from which it seems to me that we can best approach the study of inflammation as an adaptive process. With inflammation, as with other adaptive processes, any useful purpose subserved affords no explanation of the mechanism of the process. We should guard against all ideas which introduce, even unconsciously, the conception of something in the nature of an intelligent foresight on the part of the participating cells. The response of these cells in inflammation is a necessary and inevitable one determined by their innate properties. Our efforts should be directed, in the first place, toward as near an approach as possible to a mechanical explanation of inflammatory processes by a study, on the one hand, of the properties and mode of action of the causes of inflammation, and, on the other hand, of the nature and source of the cellular properties concerned. We may properly inquire whether these properties fit the cells to counteract the effects of injury, and if so, whence comes this fitness. Has the fitness those attributes of relative perfection which we find in most physiological adaptations, or is it characterized by the uncertainties and imperfections of so many pathological adaptations? Is the character of the response to injury in inflammation such as to indicate that the agencies concerned have acquired through evolutionary factors a special fitness to meet the pathological emergencies? Are all or only a part of the manifestations of the inflammatory processes adaptive?

It cannot be doubted that there are innate properties of certain cells called into action in inflammation, such as those manifested in the attraction of leucocytes and other cells by definite chemical substances, the capacity of cell-proliferation from causes connected with injury, the power of phagocytosis and other bactericidal properties, which may be adapted to counteract the effects of injurious agents. When these forces bring about the prompt destruction or removal of the injurious substances, and the defect is quickly repaired, the adaptation is complete and unmistakable. When, however, the inflammatory irritants and their destructive effects persist, and the proliferation of cells and accumulation of inflammatory products become excessive and occupy large areas, the features of adaptation are not so easily recognized. The mere occupation of territory by inflammatory products is often a serious injury, and it can be regarded as an adaptive feature only when they fill some artificial defect. Such occupation may be in itself enough to counteract any useful work in which these products may be engaged.

We can reasonably seek, in the relations of the body to the outer world, an explanation of the development of certain properties of cells which serve a useful purpose in mechanical and other injuries. These properties find application also in the normal life of the organism. Their exercise in response to injury imparts to inflammation important adaptive or protective characteristics, but I fail to see in this process any such special fitness as would justify extravagant statements which have been made to the effect that inflammation ranks among the adaptations of living beings by the side of digestion and respiration.

I have endeavored in this address to present certain general considerations concerning pathological adaptations. It has been possible to bring under consideration only a small part of an immense field, and this very inadequately. We have seen that in the sense in which adaptation was defined we can recognize in the results of morbid processes frequent and manifold evidences of adjustment to changed conditions. These adjustments present all degrees of fitness. Some are admirably complete; more are adequate, but far from perfect; many are associated with such disorder and failures that it becomes difficult to detect the element of adaptation. The teleological conception of a useful purpose in no case affords an explanation of the mechanism of an adaptive process. I have suggested that the adaptability of this mechanism to bring about useful adjustments has been in large part determined by the factors of organic evolution, but that in only relatively few cases can we suppose these evolutionary factors to have intervened in behalf of morbid states. For the most part the agencies employed are such as exist primarily for physiological uses, and while these may be all that are required to secure a good pathological adjustment, often they have no special fitness for this purpose.

The healing power of nature is, under the circumstances present in disease, frequently incomplete and imperfect, and systems of treatment based too exclusively upon the idea that nature is doing the best thing possible to bring about recovery or some suitable adjustment, and should not be interfered with, rest often upon an insecure foundation. The agencies employed by nature may be all that can be desired; they may, however, be inadequate, even helpless, and their operation may add to existing disorder. There is ample scope for the beneficent work of the physician and surgeon.

WILLIAM H. WELCH.
JOHNS HOPKINS UNIVERSITY.

THE NAPLES ZOOLOGICAL STATION.

THE Naples Zoological Station celebrated with adequate ceremonies on April 14th its twenty-fifth anniversary. The exercises of the day began at 10 o'clock in the morning by a delegation representing the students at work in the Station calling upon Dr. Dorhn and expressing to him their appreciation of the privileges which the Station afforded them. This delegation consisted of representatives of the German, Italian and English-speaking peoples, each short and pointed address being delivered in the language of the representative. Dr. Dohrn happily replied, beginning his speech in German, continuing it in Italian and closing it in English. This delegation then waited upon Dr. Hugo Eisig, who has, from the beginning, been Dr. Dohrn's first assistant.

Early in the day the entire Station fleet was anchored in the bay near the Station. This fleet consists of two small steamers, the *Johannes Müller* and the *Frank Balfour*, and six small fishing boats. In the midst of this small fleet was anchored the second-class cruiser *Fieramosca*, sent by the Italian government to do honor to the occasion.

At 2 p. m. all at present connected with

the Station, together with many friends and distinguished visitors, assembled in the lecture room of the Station to listen to the speeches prepared for the occasion. The room was beautifully and appropriately decorated. On each side of the speaker's stand were tables containing telegrams, letters and other documents conveying greetings and congratulations to Dr. Dohrn.

The speeches were delivered in German and Italian. The opening address was by Professor Todaro, of Rome, who was followed by Professor His. The latter gave some account of the history of the Station, emphasizing its usefulness in advancing biology. He was followed by Professor Waldeyer, of Berlin, who brought an address from the Berlin Academy of Sciences, and who mentioned with some feeling of pride that he was one of the first students in the Zoological Station, when its resources were small as compared with what they are to-day. The Syndic of Naples then presented Dr. Dohrn with the freedom of the city. The audience was then favored with a short address by Admiral Palumbo, Under Secretary of State, after which the Minister of Public Instruction presented Dr. Dohrn the 'Grand Ufficiale della Corona d'Italia,' and brought the congratulations of King Humbert.

The closing speech was made by Dr. Dohrn, who delivered it in German. This address was printed in Italian and copies distributed to members of the audience. Dr. Dohrn spoke pleasantly of the people of Naples and the many privileges given him by the city, making special mention of Professor Panceri, whose influence made it possible to place the Station in the beautiful park known as the *Villa Nazionale*. To the Italian and German governments he expressed his gratitude for the sympathy and aid the Station had received from these sources. On the strength of a petition signed by Helmholtz, Virchow and DuBois-Reymond, the German Parliament granted to the Station an annual subsidy which has increased to about $10,000 per year. The Academy of Sciences in Berlin, the British Association for the Advancement of Science and the Smithsonian Institution were mentioned for their aid in maintaining several tables in the Station.

Dr. Dohrn referred with much feeling to the assistance given him by his father and also the father of Mrs. Dohrn, during the early years of the Station's history. Much credit was given to Mrs. Dohrn, who always gave her sympathy and aid to the interests of the Station. The money given her by her father to furnish her house was used to assist in maintaining the Station during the critical period of its history. Much praise was also given Hugo Eisig, who when a very young man cast his lot with Dr. Dohrn, and long before the Station was an assured success. His ability, energy and kind cooperation have contributed largely to make the Station what it is to-day.

After the exercises were over the students in the Station were taken on board the man-of-war. In the evening Dr. and Mrs. Dohrn entertained the distinguished visitors at tea, and thus ended one of the most pleasant and eventful days in the Station's history. On April 17th the students of the station gave Dr. and Mrs. Dohrn a dinner at Fusaro.

During the day the writer heard Dr. Dohrn express his delight at the success and usefulness of the Station; that while its present condition was all one could wish, his hope and aim was to see it placed on such a foundation that its future usefulness would be assured. It was with a feeling of pride that we listened to him refer so kindly to an American lady who had just written him that she was succeeding nicely in securing funds with which to endow a table in the Station.

The usefulness of the Station is so well

known to American biologists that it is useless for me to add anything in the way of a detailed description of its internal management, and yet this little account would seem very incomplete without some mention of Dr. Lo Bianco, whose knowledge of the plants and animals in the Bay of Naples, and whose skill in capturing animals and preparing them for study and for museum use is remarkable.

At present two tables in the Station are supported by American institutions (Columbia University and the Smithsonian Institution), but these are inadequate to meet the demands of American students who wish to make use of the Station's privileges. Thanks are due Dr. Dohrn, who always makes room for deserving American students when it is possible for him to do so. At one time during this year there were seven Americans in the Station; at present there are four. I believe I voice the sentiments of all Americans here at present, and those who have been here in the past, when I express the wish that provisions be made by Americans or American institutions for American students wishing to study here.

S. E. Meek.

Naples.

ZOOLOGICAL SOCIETY OF LONDON.

The sixty-eighth Anniversary Meeting of this Society was held on April 29th. After some preliminary business the Report of the Council on the proceedings of the Society during the past year was read by Mr. P. L. Sclater, F. R. S., the Secretary. It stated that the number of Fellows on the 1st of January, 1897, was 3,098, showing a net increase of 71 members during the year 1896. The number of new Fellows that joined the Society in 1896 was 207, which was the largest number of elections that had taken place in any year since 1877.

The total receipts of the Society for 1896 had amounted to £27,081 which was £123 more than the very successful year, 1895. The ordinary expenditure had amounted to £23,788 which was an increase of £327 over that of the year 1895. Besides this a sum of £2617 had been paid and charged to extraordinary expenditure, of which amount £2600 had been paid on account of the construction of the new house for ostriches and cranes. A further sum of £1000 had also been transferred to the Deposit Account, leaving a balance of £1066 to be carried forward for the benefit of the present year.

The usual scientific meetings had been held during the year 1896, and a large number of valuable communications had been received upon every branch of zoology. These had been published in the annual volume of 'Proceedings,' which contained 1,110 pages illustrated by 52 plates. Besides this, parts 1 and 2 of the 14th volume of the Society's quarto 'Transactious' had been published in 1896. A new edition of the List of Animals, containing a list of all the specimens of the vertebrated animals that had been received by the Society during the past twelve years, had been published and issued to the subscribers to the publications in November last. The 32d volume of the 'Zoological Record' (containing a summary of work done by zoologists all over the world in 1895), edited by Dr. David Sharp, F.R.S., had been published and issued to the subscribers in December last.

The library, containing upwards of 20,000 volumes, had been maintained in good order throughout the year, and had been much resorted to by working naturalists. A large number of accessions, both by gift and purchase, had been incorporated.

The number of visitors to the Gardens in 1896 was 665,004, being 322 less than the corresponding number in 1895. This slight decrease was easily accounted for by

the unsettled state of the weather in the latter part of the past year.

The number of animals in the Society's Gardens on the 31st of December last was 2,473, of which 902 were mammals, 1,132 birds and 439 reptiles and batrachians. Amongst the additions made during the past year 18 were specially commented upon as of remarkable interest, and in most cases new to the Society's collections. Amongst these were a young male Manatee from the Upper Amazons, a young male Klipspinger from northeast Africa, a young female Gorilla from French Congoland, a pair of lettered Aracaris from Pára, a young Brazza's Monkey from French Congoland, a Loder's Gazelle from the Western Desert of Egypt, three Ivory Gulls from Spitzbergen and three Franklin's Gulls from America. A serious loss was occasioned to the Society's menagerie by the sudden death, in March last, of the male Indian Elephant (Jung Pasha), deposited in the Gardens by H. R. H. The Prince of Wales on his return from India in 1876, and for the past twenty years well known to all visitors to the Gardens.

A vote of thanks to the Council for their report was then moved by Dr. Henry Woodward, F.R.S, seconded by Lord Medway, and carried unanimously.

The report having been adopted, the meeting proceeded to elect the new members of Council and the officers for the ensuing year. The usual ballot having been taken, it was announced that William Bateson, Esq., F.R.S., Col. John Biddulph, Dr. Albert Günther, F.R.S., Osbert Salvin, Esq., F.R.S., and Joseph Travers Smith, Esq., had been elected into the Council in the place of the retiring members, and that Sir William H. Flower, K.C.B., F.R.S., had been re-elected President; Charles Drummond, Esq., Treasurer, and Philip Lutley Sclater, M.A., Ph.D., F.R.S., Secretary to the Society, for the ensuing year.

CURRENT NOTES ON ANTHROPOLOGY.

PRIMITIVE SYMBOLIC DECORATION.

Two articles have lately appeared which are worth a comparison. The one is by Mr. C. C. Willoughby, of the Peabody Museum, Cambridge, in the *Journal of American Folk-lore* for March, on the decorations upon pottery from the Mississippi valley. It is a recasting of that read by himself and Professor Putnam before the American Association in 1895. He points out a variety of simple designs which he identifies as 'cosmic symbols,' 'sun symbols,' others for the winds, the clouds, the bird, the band, etc. Of course, the svastika, the triskeles and the cross come in as other 'symbols.'

This is one view to take of the aim of primitive decoration, and it is now in the ascendant in the United States. But in France they think otherwise. In the *Bulletin of the Paris Anthropological Society* (1896, Fasc. 6) M. Regnault has an article on the beginnings of ornamental art among primitive peoples, in which he explains such figures as the natural result of crossing lines, joining angles, repeating designs, connecting curves, etc., all this in the most simple manner and without any occult or mystic intent whatever. They were mere decorative sketches, 'only this and nothing more.'

It is easy to read into barbaric scratches the thoughts of later times, and we must acknowledge that something more besides the figure itself is needed to prove its symbolic sense.

MAN'S SPEECH TO BRUTES.

A PRIMITIVE myth asserts that in the good old times men and brutes conversed together understandingly. How limited their intercourse by speech now is may be learned from Dr. H. Carrington Bolton's paper in the *American Anthropologist*, 'The language used in talking to Domestic Animals.'

He has collected numerous specimens from various countries, and reaches some interesting conclusions. Thus it appears that the terms used in calling animals are generally corruptions of their names, and usually the expressions addressed to them are from the language of the place. Certain inarticulate sounds, as the click, used with us to start horses, and the chirp, uttered to hasten their pace, are in vogue in remote lands also, as in India, but with a reverse meaning. Even between France and Switzerland such examples of counter-sense are quoted. This illustrates that the adoption of these sounds is purely conventional, and the only curious feature remains that the same sound is repeated in widely different localities. There is also evident an unconscious attempt on the part of man to lower his language to the comprehension of the brute by abbreviations.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

ASTROPHYSICAL NOTES.

THE Harvard Observatory makes an important contribution to astrophysics in Part I. (pp. 1–128) of Vol. XXVIII. of its Annals. This contains a discussion, by Miss A. C. Maury, under the direction of Professor E. C. Pickering, of the spectra of the brighter stars photographed with the eleven-inch Draper telescope. This laborious investigation has involved the examination of nearly five thousand photographs of 681 stars north of 30° south declination, and has been in progress for several years. From one to four prisms were placed before the object-glass, and the length of the photographed spectrum, between the hydrogen lines β and ϵ, was from 2 to 8 cm. accordingly.

A scheme of classification was outlined by Miss Maury, containing 22 groups of spectra, with three 'divisions,' *a*, *b* and *c*, into which each group might be subdivided according to the appearance of the lines present in it. The groups are presumed to represent in some degree successive stages of stellar development, I to V containing spectra of the Orion type (Vogel's II *b*), while groups VII to XI, XIII to XVI, and XVII to XX respectively include Secchi's first, second and third types. VI and XII are considered as transitional groups. Group XXI is Secchi's type IV, and XXII is Pickerings fifth type—bright-line stars and planetary nebulæ. Typical stars of each group are cited, and about forty pages are given to a detailed description of the characteristics of each group. The desirability of the introduction of a new classification of stellar spectra may be open to question, but there can be no doubt that the results of minute study of spectra must be expressed in some systematic way, since gradations of spectra are perfectly evident. Miss Maury is quite justified in thus systematizing her work, as she has done without undue reference to theories of development. It is, however, hardly to be expected that this classification will be generally adopted. The time has not yet come for general agreement on stellar classification. Further laboratory researches and theoretical investigations upon luminescence must be awaited before stellar spectra can be interpreted.

Separate chapters are devoted to the Orion lines;* to the solar lines between λ 3686 and λ 5896 with their occurrence and intensity in the stars, to the lines in stars of division *c*, and to the relative intensities of lines. Chapter VIII. contains a table of the stars in their order by groups and subgroups or divisions, followed by several pages of valuable notes on individual stars. Chapter IX. is a general catalogue of the stars investigated, in order

*The identification of these lines with those of heilum was discovered too late for discussion until the close of the volume.

of right ascension, with assignment to group and reference to the numbers of the plates.

The tabular form of statement of results, which has become rather characteristic of the Harvard Annals, is followed in this volume. It is sometimes doubtful whether the compactness thus gained compensates for the difficulty of understanding the tables without minute study of them—a difficulty especially felt by foreigners. The notes on individual stars would be more convenient if the name of the star had been used, besides the reference number.

Although the quantitative accuracy of the spectrograph cannot be expected of the objective-prism, yet it seems adequate for the purposes of the volume under review. The objective-prism alone could collect such treasures of information as are included in the vast number of photographs stored in the Harvard Observatory and drawn upon in successive annals.

THE *Atlas der Himmelskunde*, of which the first of its thirty parts is at hand, is chiefly devoted to the reproduction of recent astronomical photographs. The author, A. von Schweiger-Lerchenfeld, has had the assistance of numerous astronomers and instrument makers in preparing this work, which promises to fully represent—especially by its five hundred excellent engravings and half-tones—the instruments and results of modern astro-photographic research. (Wien und Leipzig, A. Hartleben's Verlag.)

E. B. F.

CURRENT NOTES ON METEOROLOGY.

RECENT ARTICLES ON KITE-FLYING.

THE rapidly increasing interest that is being taken in kite-flying is shown by the fact that the May number of the *Century Magazine* contains three articles on the subject. The first, by J. B. Millet, the only one which deals more particularly with the meteorologic aspect of the matter, is entitled *Scientific Kite-Flying* and presents the general facts regarding the different forms of kites and the methods of work and the results obtained at Blue Hill Observatory. The second article, *Experiments with Kites*, is by Lieut. Wise, of the U. S. Army, and describes the experiments made by him at Governor's Island, New York Harbor, with an account of the ascent of January 22, 1897, on which day Lieut. Wise was lifted 42 feet from the ground by means of four kites. The last article, by W. A. Eddy, on *Photographing from Kites*, concerns the experiments made with a camera carried up by kites and also gives an account of the first telephoning and telegraphing through a line held by kites. All the articles are illustrated and will undoubtedly attract considerable attention. Although kites can be used for many purposes, the interest that meteorologists have in kite-flying is limited chiefly to the possibility of elevating self-recording instruments to considerable heights above sea level by this means. It is this exploration of the free air by means of meteorographs sent up on kite lines which has been so actively and so successfully carried on at Blue Hill Observatory, as already stated in these Notes.

DEFORESTATION AND CLIMATE.

CLIMATIC descriptions contain frequent allusions to the supposed influence of deforestation on climate, although we have not as yet enough reliable meteorological data to warrant our holding any definite opinion as to this influence one way or the other. In a lecture on the diamond mines of Kimberley, delivered at the Imperial Institute, London, on November 16th last, and reported in a recent number of *Nature* (April 1), Dr. Wm. Crookes, F. R. S., referred to the deforestation which has been going on around Kimberley and to the change in climate which is believed to have resulted from this deforestation. It is reck-

oned that over a million trees have been cut down to supply timber for the diamond mines, and the whole country within a radius of 100 miles has been denuded of wood, with the most injurious effects on the climate, as is generally believed there. The absence of trees to break the force of the wind and temper the heat of the sun, combined with the extreme dryness of the air, is thought to account for the dust storms so frequent in that region in summer.

ACCLIMATIZATION OF THE ENGLISH IN CEYLON.

IN connection with the acclimatization of Europeans in the tropics, to which reference was recently made in these Notes, a statement made by a recent writer on Ceylon, who was for many years Judge of the Ceylon Supreme Court, may be of interest. The quotation, which is from an article in the *Scottish Geographical Magazine* for April, is as follows: "When all is said, in a tropical climate, even of the best, we live, as it were, on sufferance, and the climate tells on the next generation. For every one of us who has his livelihood in Ceylon there comes the inevitable day when he must part from his children and send them home. This stern necessity has been styled a price which we must pay our Eastern possessions; and a heavy price it is." The pathetic strain of such a statement serves to emphasize anew the lesson that complete acclimatization of northern Europeans in the tropics is impossible.

RECENT PUBLICATIONS.

F. H. BIGELOW: *Storms, Storm Tracks and Weather Forecasting.* Bulletin No. 20. United States Department of Agriculture, Weather Bureau, 8 vo., Washington, 1896. Pp. 87. Charts 20.

I. H. CLINE: *Influence of Climatic Conditions and Weather Changes on the Functions of the Skin.* Reprinted from Proc. Texas State Medical Association, 1896. Pp. 8. Chart showing the pathological distribution of climate in the United States.

R. DE C. WARD.
HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

THE University of Toronto has conferred the degree of LL.D. on Sir John Evans, President of the British Association for the Advancement of Science; on Dr. Wolcott Gibbs, President of the American Association for the Advancement of Science, and on three of the most distinguished English men of science, who are expected to attend the Toronto meeting of the British Association: Lord Lister, Lord Kelvin and Lord Rayleigh.

THE third annual meeting of the Botanical Society of America will be held in Toronto on Tuesday and Wednesday, August 17th and 18th, 1897, under the presidency of Dr. John M. Coulter. The Council will meet at 1 p. m. on Tuesday, and the first session of the Society will begin at 3 p. m. The address of the retiring President, Dr. Charles E. Bessey, will be given on Tuesday evening at 8 o'clock. The British Association for the Advancement of Science will meet in Toronto, August 18th to 25th. The opening address is to be given on Wednesday evening, August 18th. A fairly large contingent of British botanists and some Continental botanists of note are expected. This meeting will, therefore, probably give unusual opportunities for renewing or forming acquaintances. All foreign botanists present will be invited to sit as associate members of the Society and to read papers. This invitation will be addressed personally to all whose intention to come to Toronto is known, and will also be made known through the scientific papers.

MISS CATHERINE W. BRUCE, of New York City, has again shown her great interest in astronomy by sending Professor J. K. Rees, Director of the Columbia University Observatory, a check for fifteen hundred dollars ($1,500). The money is to be used in publishing the observations and reductions for 'Variation of Latitude and the Constant of Aberration,' made by Professors Rees and Jacoby and Dr. Davis. To this fund for publication there had been

contributed previously a donation of one hundred dollars ($100) by Mrs. Esther Herrman, of New York City. Mrs. Herrman's interest in scientific matters has been evidenced by many generous gifts to the New York Botanical Gardens, the New York Academy of Sciences, etc. The intelligent interest of women in all original work in science has been exhibited abundantly in the past few years, and astronomy especially has been generously aided by the contributions of such women.

HENRY G. BRYANT, of Philadelphia, accompanied by S. J. Entrikin and E. B. Latham, has started for Alaska for the purpose of climbing Mt. St. Elias and making explorations in the adjacent region. Mr. Bryant, as is well known, has had experience in exploration in Labrador, and has made summer trips to Greenland. Mr. Entrikin was with Peary in Greenland and made an expedition over the inland ice. Mr. Latham is a member of the U. S. Coast Survey, and goes equipped for geographical work. The party will be increased by three or four camp hands in Seattle, and will establish a base camp on the west shore of Yakatat Bay early in June. Their plan is to cross the Malaspina glacier to the Samovar Hills; from there ascend the Agassiz glacier, and thence up the Newton glacier to the divide between Mt. Newton and Mt. St. Elias. A camp will be established on the divide, elevation about 13,000 feet, from which the ascent to the summit of Mt. St. Elias will be made. On returning to the Samovar Hills the explorations will be continued westward through an entirely unknown region until a pass is discovered which will enable the explorers to cross the St. Elias Mountains and gain one of the branches of Copper River. The return to the coast will be by way of Copper River. The party is well equipped and has every prospect of success.

DR. E. J. STONE, F.R.S., the well-known astronomer, Radcliffe Observer, at Oxford, died on May 9th. Mr. A. D. Bartlett, Superintendent of the London Zoological Society's Gardens, died on May 7th at the age of 85. He had contributed many valuable papers to the meetings of the Society. Mr. Legrand Des Cloizeau, formerly professor of mineralogy at the Paris Museum of Natural History, member of the Section of Mineralogy of the Paris Academy, died on May 8th, aged 79 years. Mr. Theodore Bent, known for archæological and geographical explorations, died on May 5th from the effects of malarial fever, contracted while carrying out explorations in Arabia.

AMONG the deaths at the fire in the Paris Charity Bazaar was that of Dr. Feulard, a well known student of dermatology. He had taken his wife out of the building and was killed while returning to rescue others.

MR. F. D. GOODMAN, F.R.S., has been elected President of the British Ornithologists' Union.

THE custodianship of the Great Serpent Mound in Adams county, Ohio, has been transferred by the Peabody Museum of Harvard University to the Ferris Memorial Library of Madisonville.

THROUGH the influence of President David Starr Jordan arrangements have been made for the establishment of zoological gardens in San Francisco.

THE report of the committee of the National Academy of Sciences on a forestry policy for the United States was ready on May 1st, but has been delayed in printing. It is now expected, however, that the complete report will be sent at once to Congress by President McKinley.

THE twenty-sixth Congress of the German Surgical Society was held at Berlin from the 21st to the 24th of April. It appears from the account in *Die Natur* that special attention was given to the applications of X-rays to surgery.

IN addition to the Section of Nervous and Mental Diseases of the International Medical Congress at Moscow, there is to be held an International Congress of Neurology, Psychiatry and Medical Electricity and Hypnotism, from the 16th to the 19th of September, in connection with the Brussels International Exposition. The English program for this Congress is sufficiently curious to deserve quotation. Among the questions submitted for special discussion are: 'Influence of the Delivery on the Nervous and Mental Diseases presented later by Children,' and 'The Question of Criminal Suggestions: its Origins and Actuel State.' Among

items given under 'Advice' are "The personal communication may not dure longer as twenty minutes unless the President finds that the duration may be prolonged," and "Independently of the questions treated by the reporters, members are authorized to do personal communications."

IN connection with the International Medical Congress at Moscow a two weeks' excursion has been arranged to the Caucasus, visiting the celebrated mineral baths of which Kislovodsk is the center and traversing the region notable for its fine scenery. The members of the Congress will be charged only thirty dollars for transportation and for sleeping accommodation on the trains and steamboats.

AT the Child-study Conference held recently at Chicago a North American Child-study Association was formed with the object of establishing State Societies and promoting the interests of the work.

MRS. ELLEN B. FRENCH has bequeathed $5,000 to Beloit College on condition that no vivisection shall ever be practiced there. Should this condition not be accepted the money goes to the American Humane Society of Boston.

THE last of the public lectures of the present year before the New York Academy of Sciences will be delivered this evening by Dr. Harwood Huntington, his subject being 'The Technology of Cotton Cloth.'

THE Swiss Zoological Society, founded in 1894, has undertaken to prepare a *Fauna Helvetica.* Preliminary studies are being encouraged with this end in view and are published in the *Revue Suisse de zoologie*, edited by Dr. Bedot.

THERE is to be held, in conjunction with the Brunswick meeting of German men of science and physicians, an exhibition of scientific objects and instruments. It is expected to make the exhibit in scientific photography especially complete, this year being the first in which that subject is represented by a special section.

IT has been the custom at the annual meetings of the British Medical Association to have an exhibition of pathological and anatomical specimens, and of apparatus more especially connected with the teaching and demonstration of anatomy, physiology and pathology. This year the Museum will be held in the dissecting room at McGill University, where ample accommodation and light is afforded to demonstrate the specimens to every advantage, while, to further aid the exhibition, a special grant has been obtained from the general committee. It is suggested that a special feature of the year's exhibit should be a collection of photographs and micro-photographs, illustrating interesting abnormalities of any kind whatsoever.

AN observatory is to be established at Odessa as a branch of the observatory at Pulkowa.

THE lenses for the great telescope of the Yerkes Observatory were shipped from Cambridge on May 17th on a special parlor car, in the care of Mr. Alvan G. Clark and two assistants.

THE Anatomical Society of Great Britain and Ireland will hold its annual summer meeting on June 10th and 11th. An evening address will be given by Professor His, of Leipzig.

Nature states that the Geological Commission of Cape Colony has published a bibliography of South African geology, containing a list of nearly 600 papers.

THE Berlin Academy of Sciences has granted Professor Paschen, of Hanover, M. 1,100 for experiments on the energy of the spectra of dark bodies, and M. 1,000 to Dr. Hertz for the reduction of observations from the Kuffner Observatory.

WE learn from *Nature* that the Committee of the Puffin Island Biological Station have decided to offer facilities to students and others for the pursuit of scientific research at the Station during the summer months. The island is well situated for the study of both marine zoology and ornithology, and the Station is provided with sleeping accommodation in addition to the usual laboratories. Those wishing to avail themselves of the present opportunity should communicate with the Director, Professor P. J. White, University College of North Wales, Bangor.

THE Italian correspondent of *The Lancet*

writes of the destruction of Captain Bóttego while engaged in exploring the basins of the Gava and of the Omo, the regions between the Nile and Lake Rodolfo. Captain Bóttego left Brava in the Benadir on October 12, 1895; reached Lug on November 18th, founded the station, started on December 27th with 180 men along the Ganane and the Gava, and kept the Geographical Society informed of his successes till April 22, 1896, when it forwarded him news of the disasters in Abyssinia. The bearer of this reached Lug in May and started in quest of the expedition. Meanwhile indirect news of Captain Bóttego and his column as late as October last represented him as having gained the south shore of Lake Rodolfo on his return journey, and further tidings reached London that he was making for the coast of the Indian Ocean, till on April 23d King Menelik received a despatch announcing that on the Ethiopian frontier towards Baro Captain Bóttego had come into conflict with a native tribe and had been killed, that two other Italians were made prisoners, and that the fourth Italian member of the expedition had not been heard of. Whether this is the medical officer, Professor Maurizio Sacchi, an able naturalist, is not yet known.

WE have already called attention to the International Congress of Mathematicians to be held at Zurich. According to the *Bulletin of the American Mathematical Society* the local committee announces the following general program: Meetings of the entire Congress will be held on Monday, August 9th, and Wednesday, August 11th, at which questions of a more general character will be discussed. Papers dealing with special subjects will be presented before the various sections on Tuesday, August 10th. The Congress will direct its attention not only to purely scientific questions, but also to matters of an executive and business nature, such as questions of bibliography, lexicography, terminology, cooperative scientific undertakings, including historical investigations, comprehensive reports, the publication of treatises, the holding of expositions, etc.

AN article in a recent issue of the London *Times* advocates the renewal of Antarctic exploration under the auspices of the British government. Belgium will send out an expedition next September to the neighborhood of the Antarctic, but it will be a small one and will devote itself mainly to oceanographic work in the vicinity of Graham's Land. There has been some talk of a German expedition, but the collection of the necessary funds seems to be making slow progress. It is estimated that the cost of an expedition need not exceed £50,000. The writer of the article says that there is reason to hope that, if the Government decides not to intervene, the Royal Geographical Society is prepared to attempt to organize an expedition to the Antarctic and so save the credit of England. It was primarily at the instigation of this Society that Ross's expedition was sent out over half a century ago, and many other expeditions hardly less formidable have been equipped under the auspices, and partly or wholly at the expense, of this Society. Obviously in this case, however, the funds required are beyond its means. But there can be little doubt that, if the Society is in earnest about an Antarctic expedition, there are men able and, if appealed to in the right way, willing to follow the brilliant example set by Mr. Harmsworth. Under its present able, energetic and enthusiastic President, Sir Clements Markham, the Society need not hesitate to enter upon this enterprise. Moreover, it is impossible not to believe that the Government, if once the enterprise were fairly started, would lend its aid in one shape or another.

THE May number of the *Engineering Magazine* contains an account taken from French technical journals of the *Société des Ingénieurs Civils de France* and its new building. The Society was organized in 1848 with a membership of 134. The membership now reaches a total of 2,724, and the Society stands as one of the leading professional organizations of Europe. Its monthly transactions, '*Memoires et compte rendu des travaux de la Société des Ingénieurs Civils de France*,' are everywhere recognized as the record of the best work of French engineers, and membership in the Society is an acknowledged mark of professional eminence. A new building has been recently constructed for the

use of the Society in Paris, the dedication ceremonies having taken place on January 14th, President Faure assisting. The cost of the building alone was $100,000, to which must be added the cost of the ground, $80,000. On the ground floor is the large meeting room, which, including the communicating conversation room, measures 72x49 feet, and is of interest because of the peculiar construction of the floor, whereby it may be mechanically lowered at the platform end and thus in a few minutes be converted into a sloping hall for meetings. The upper floors, in addition to offices, committee rooms, etc., contain ample room for the valuable library, a laboratory, a photographic room and the residence of the General Secretary. The building was constructed in the short space of nine months from designs by Professor Delman, in the style of architecture of Louis XIV.

IT is stated in the *British Medical Journal* that a professor of the Paris Natural History Museum accidentally discovered an entrance into subterranean passages running underneath the Jardin des Plantes and a part of the Boulevard Saint-Marcel. The archives of the Museum furnish proof that these galleries were constructed by the Romans; in the fifteenth and eighteenth centuries they were repaired and consolidated, and are now in perfect order. Nothing is known as to the purpose they served. M. Armand Viré, a corresponding member of the Museum, asked for permission to use the passages as a laboratory for researches on animal life inhabiting caverns, and studying the successsive phases in the transformation of these degenerate forms of life, and the laboratory was inaugurated a few days ago. M. Viré, followed by fifty invited guests, bareheaded and stooping, each carrying a candle, traversed the labyrinth of galleries until they reached a round hall, the roof of which is supported by a stone column. This is the principal laboratory. It contains stone tables with perfectly flat surfaces. The water supply is assured by a good system of pipes. Seine water was in the first instance used, but the animals died. They were replaced by others, which were given spring water and are in a flourishing condition.

UNIVERSITY AND EDUCATIONAL NEWS.

CAMBRIDGE UNIVERSITY rejected, on May 21st, the proposal to confer degrees upon women by a vote of 1,713 to 662.

A COMMITTEE of the Board of Trustees of the College of the City of New York has recommended that eight assistants be appointed to assistant professorships, with salaries from $2,500 to $3,500, according to term of service. The promotions are expected to include Charles A. Doremus, chemistry and physics; Ivan Sickles, natural history; and Gustave Legras, J. R. Sim and C. R. Smith, mathematics.

MISS MARY CLOYD BURNLEY, of Swarthmore, Penn., who will receive the degree of B.A. from the Woman's College of Baltimore in June, has received the fellowship in chemistry from Bryn Mawr College for next year. Miss Burnley also receives a summer scholarship in biology at the Marine Biological Laboratory at Wood's Holl, Mass., from the Woman's College.

DR. FRECH has been promoted to a full professorship of geology in the University of Breslau, Dr. Carl Paal to a full professorship of pharmaceutical and applied chemistry in the University of Erlangen, and Dr. Raphael Freiherr v. Erlanger and Dr. Paul Samassa to associate professorships of zoology in the University of Heidelberg. Dr. Bredt, of Bonn ,has been made full professor of chemistry in the Polytechnic Institute at Aix, and Professor Franz Meyer, docent in mathematics in the School of Mines at Klausthal, has been called to the University of Königsburg.

A SPECIAL course in paleontologic geology will be given by Mr. Stuart Weller at the University of Chicago during the summer quarter beginning July 1st. The course will be devoted to the laboratory study of fossil invertebrates. Its aim will be to give instruction and training in the identification of fossils and in the interpretation of fossil faunas. The work will be entirely individual in its character and will be adapted to the special wants and needs of each student. The offering of the course is experimental and its repetition will depend upon the demand which may be found for it. There will accompany this a class-room course

in Geological Life Development by Mr. Weller. The usual courses in general and special geology will be given by Professor Salisbury during the first half of the summer quarter, followed by his field course during the second part.

MR. FRANCIS H. SCOTT writes us that the bill before the Legislature to change the name of the Michigan Mining School to the Michigan College of Mines became a law early in April, and the latter is now the proper name of the institution. The students and the people of the Upper Peninusula generally have accepted the new name gladly, considering it much more appropriate for the character of the work done in the institution. Another bill which has been pending for some time regarding the charging of tuition has been passed, fixing the rate at $25.00 for residents of Michigan, and not less than $50.00 or more than $200.00 for those residing outside of Michigan. The rate is under consideration and, in all probability, will be fixed at $150.00. This tuition fee will correspond with that charged by other first-grade technical schools in America, such as Columbia College School of Mines, the Rensselaer Polytechnic Institute, the Stevens Institute of Technology and the Massachusetts Institute of Technology. When the school was working out its policy, trying to solve its educational problems, it was thought wisest to charge no tuition, but to collect as wide a constituency as possible in order that there might be all possible chance to make the methods as broad and thorough as could be done. It was also deemed hardly just to the students educated here to demand tuition until the institution was much better equipped for its work than the appropriations granted during the first decade of its existence permitted. Now, that success has been attained in educating men for practical work, as is evidenced by the positions which its eighty-six graduates hold, as given in the last catalogue, the institution seems fully warranted in charging hereafter for its instruction. The new law goes into effect immediately after August 19, 1897, and will, therefore, not apply to students entering previous to that time. A prospectus will soon be issued by the College, giving the details of the regulations finally adopted by the Board of Control.

DISCUSSION AND CORRESPONDENCE.

DISTRIBUTION OF MARINE MAMMALS.

TO THE EDITOR OF SCIENCE: Without discussing the general questions treated in Dr. Sclater's paper in SCIENCE of May 14th, it may be well to call attention to some errors of detail.

Dr. Sclater credits the North Atlantic region (Arctatlantica) with the exclusive possession of the genera *Delphinapterus* and *Monodon* and the species *Balæna mysticetus*.

Monodon, though rare, occurs in the region of Bering Strait, while it is not known, as yet, to enter Bering Sea.

Delphinapterus is abundant in Bering Sea, often ascending the large rivers which fall into that sea. Specimens have been noted in the Yukon 600 miles from salt water.

Balæna mysticetus, though now nearly exterminated, was a short time ago the principal object of the whale fishery of the North Pacific, Bering and Okhotsk seas. During the early days of the whale fishery several well attested instances occurred of whales (*B. mysticetus*) struck in one ocean, as the Atlantic, being afterward killed in the North Pacific, and *vice versa*.

It may also be mentioned that less than ten years ago a herd of over 200 fur seal were noted on one of the Galapagos Islands and an expedition was fitted out to go there for the purpose of hunting them.

WM. H. DALL.

SMITHSONIAN INSTITUTION, WASHINGTON,
May 16, 1897.

A POSTSCRIPT ON THE TERMINOLOGY OF TYPES.

MR. LUCAS' remarks might have been more intelligible to me had they followed instead of preceded the lucid paper by Mr. Schuchert: 'What is a type in Natural History?' (SCIENCE, N. S., V., pp. 636–640, April, 1897.) To save further misapprehension, permit me to add that under 'type-specimens' I included 'holotypes,' and at all events the more important 'cotypes' and 'paratypes.'

This slight misunderstanding shows how necessary the definition of these terms has become. It also exemplifies a danger that needs constant guarding against, namely, the employment of a common word in a restricted or altered technical sense. The man in the street

knows the meaning of 'type' and 'typical,' but the meaning of those terms to the zoologist is something quite different. The scientific man is constantly hampered by the formalities of his science; and zoology is not advanced by the fact that the holotype, and perhaps the paratypes, of a species are often aberrant forms, *i. e.*, are *not* typical in the ordinary English sense. Of this no instances need be quoted.

Now while many individuals of a species may be typical (in the ordinary sense), we can conceive of one form, not necessarily existing, that represents a kind of central type, or, as I have expressed it elsewhere, a composite portrait of the species. It is this that is the 'type' of the man in the street. Instances of this are to be found in the statistical tables of Galton, Weldon, Bateson and others; a type-formula for *Ranunculus repens* was given by Pledge in *Natural Science* for May, 1897; but some of the most interesting are J. M. Clarke's studies of *Leptodesma* (*Amer Geol.*, April, 1894, and *Nat. Sci.*, June, 1894).

For this kind of type, far removed from a type-specimen, we want a name; and as the word type has been stolen from us it will save confusion to avoid it altogether. J. M. Clarke used 'fundamentum' as an alternative; but other American biologists attempted to use this as the equivalent of *Anlage*, while the fundament of man in the street is quite a different anatomical conception. Perhaps the word 'norm,' with its adjectival form 'normal,' would give the meaning most nearly, though 'normal has, of course, its more literal sense of 'at right angles to.' The norm of a species varies with locality or with horizon, becoming in the former case the norm of a subspecies, in the latter case the norm of a mutation. So also one can sometimes imagine the norm of a genus; and how very different a thing that would be from the type-species, at least of many genera! The genus norm also may vary with locality. Thus the species of *Gissocrinus* in Gotland group themselves around *G. typus*, but those in England around *G. goniodactylus*.

This conception of the norm will probably be found at least as helpful as that of the 'hypoplastotype.' It would be of value if it did no more than draw our thoughts from the wearisome history of human error back to the facts of nature.

With reference to what Mr. Schuchert calls a 'plastotype,' but which I would as lief call a 'cast o'type,' or perhaps 'electr-o-type,' may I put to him the case of a cast made from a natural matrix which has subsequently been partly destroyed, in order to expose its inner recesses more fully or to admit of the extraction of the cast? Such a cast would preserve features that could never again be shown by the matrix, and might therefore find a place in the hierarchy labelled 'type material' by Mr. Schuchert.

Another question. When the holotype and paratypes of a species have gone the way of all flesh; when topotypes are impossible and metatypes unknown; when even its plastotypes are not to be had—then what are we to call the specimen selected for special description by the reviser and reestablisher of the species? Should it not be something distinct from the ordinary 'hypotype?' But this subject of hypotypes offers so wide a field for the neologist that prudence bids me cease. F. A. Bather.

British Museum (Natural History).

'ORGANIC SELECTION.'

To the Editor of Science: In Science for April 23, 1897, J. Mark Baldwin submitted, in a paper headed 'Organic Selection,' an hypothesis which he implies to have originated 'in certain recent publications' by H. F. Osborn, C. Lloyd Morgan and himself in the year 1896. The hypothesis is based on the idea that characters acquired during the life of an individual are, to a considerable extent, those characters which cause the survival of that individual; or, in other words, that an organism which varies not only because of variations in the germ-cell, whence it evolves, but also because of the variety of forces acting on it while it is so evolving (especially after birth), and, on account of these variations, survives and reproduces at the expense of other organisms, must so survive partly on account of the one set of variations and partly on account of the other set. On this basis it is argued that, as connate characters in general persist, those particular connate characters which are identical with those acquired characters with which they coexist and to the virtue of which the survival of

the individual is in part due will persist in the next generation; and, furthermore, that there will arise, by like processes in successive generations, an accumulation of such connate characters. Hence, it is said there may appear to be an inheritance of acquired characters where, in reality, there is only an accumulation of connate characters identical with the acquired characters which, as it were, shield the connate characters while they are accumulating in successive generations.

My intention is not to discuss the merits of this hypothesis, but to say that, if I understand it, it is by no means new. It was clearly set forth by Herbert Spencer, in his 'Principles of Biology,' in the year 1866. Though it may have been presented by him or by others before that time, in writings of which I am uninformed, it will be of interest to examine the following statement of it in the work referred to:

"The working out of the process is here somewhat difficult to follow; but it appears to me that as fast as the number of bodily and mental faculties increases, and as fast as the maintenance of life comes to depend less on the amount of any one, and more on the combined action of all; so fast does the production of specialties of character by natural selection alone, become difficult. Particularly does this seem to be so with a species so multitudinous in its powers as mankind; and above all does it seem to be so with such of the human powers as have but minor shares in aiding the struggle for life—the esthetic faculties, for example.

"It by no means follows, however, that in cases of this kind, and cases of the preceding kind natural selection plays no part. Wherever it is not the chief agent in working organic changes, it is still, very generally, a secondary agent. The survival of the fittest must nearly always further the production of modifications which produce fitness; whether they be modifications that have arisen incidentally, or modifications that have been caused by direct adaptation. Evidently those individuals whose constitutions or circumstances have facilitated the production in them of any structural change consequent on any functional change demanded by some new external condition, will be the individuals most likely to live and to leave descendants. There must be a natural selection of functionally-acquired peculiarities, as well as of incidental peculiarities; and hence such structural changes in a species as result from changes of habit necessitated by changed circumstances, natural selection will render more rapid than they would otherwise be." (Prin. of Biology, Vol. 1, p. 454.)

ROBERT M. PIERCE.

PHILADELPHIA, PA.

EUPROCTIS CHRYSORRHŒA IN MASSACHUSETTS.

ON May 13th Dr. Roland Thaxter brought me a few larvæ he had found on pear trees in Cambridge. After examination I identified these as *Euproctis* (*Porthesia*) *chrysorrhœa* Linné, commonly called the Goldtail, a species hitherto unrecorded from this country. It occurs locally in England, is abundant in central and southern Europe, and is also recorded from northern Africa and Asia Minor. When found in great profusion their ravages are exceedingly serious.

May 15th, Dr. Thaxter and I visited a locality in Somerville, not far from the Cambridge line, and found the larvæ extremely abundant on pear, and somewhat less so on apple. We were told that they were noticed last spring for the first time and that they fed only on pear and apple. The larvæ feed gregariously and build small, tent-like nests. A slight jar causes them to drop from the trees and they give rise to further annoyance by the urticating power of their hairs. The larva may be described briefly as blackish with ochreous hairs, dorsal line double with pale ochreous, reddish markings, subdorsal line broad, with interrupted white markings; the tenth and eleventh segments have a conspicuous, dorsal, red tubercule. The head and thorax of the moth are white; the abdomen is white, with a brown or buff anal tuft; the wings are pure white, frequently with a black spot on the lower posterior margin of the fore wings. The alar expanse is 32–38 mm.

As previously stated, they have been found to feed here only on pear and apple, and the attempts I have made to effect a change of food have, thus far, failed. Abroad, however, the species has many food plants, apple, pear, plum, hawthorn, bramble, elm, willow, beech, oak, hazel nut, and hornbean being among those recorded. At present the larvæ seem to be confined to a rather limited area in Somerville and Cambridge. It is difficult to give an adequate idea of their abundance, their increase since last year, and their destructiveness. If the

species should become well established it will prove especially harmful; vigorous measures should, therefore, be taken to prevent its spreading.

SAMUEL HENSHAW.

CAMBRIDGE, May 17, 1897.

SCIENTIFIC LITERATURE.

Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Herausgegeben von der Deutschen Zoologischen Gesellschaft. Generalredakteur: FRANZ EILHARD SCHULZE. Berlin, R. Friedländer und Sohn. 1897.

IT is about a hundred years since the last editions of Linnæi Systema Naturæ appeared, pretending to give a systematic descriptive enumeration of all natural history objects known at that time. Those were days when one man could undertake such a work including all the known animals, plants and minerals. In most cases these editions were baseless and uncritical compilations, but, nevertheless, their influence was so stimulating that before the end of the eighteenth century the task of keeping these descriptive lists up became impossible. The three kingdoms separated first, but even the animal kingdom alone got beyond the control of the zoologists, and no descriptive list of all the animals was undertaken till our days, as Cuvier's Regne Animal did not pretend to take cognizance of any but the more common or remarkable forms.

The only publications of recent years, however, which, if kept up, would finally present in one series descriptions of all known animals are the catalogues of the specimens in the British Museum, but on the scale upon which these volumes are planned it will take ages before the task can be completed.

Recognizing this, the German Zoological Society has boldly stepped to the front and not only planned, but actually begun, a publication which intends to embrace systematic diagnoses of all living animals under the title 'Das Tierreich.' The plan of this gigantic undertaking is as follows:

The various groups of animals are to be worked up by specialists, a list of sixty-four colaborators having already been published. Their work is to be supervised by a number of division editors, twenty-one of whom are named. At the head of the whole, as editor-in-chief, is Dr. F. E. Schulze, of Berlin, assisted by an editorial committee consisting of the President of the German Zoological Society and Dr. K. Möbius, in Berlin.

In order to obtain uniformity, certain rules have been adopted: thus the nomenclature is to follow the canons of the German Zoological Society; the color designations are to be according to Saccardo's Chromotaxia, the abbreviations are to be uniform, etc.; subspecies are to be recognized; a short diagnosis of each form is to be given, accompanied by a list of all synonyms since 1758, as well as references to the most important literature and a brief statement of the geographical distribution; systematic synopsis of groups and keys to facilitate identifications are to be a special feature, and diagrams and figures in the text will illustrate the more difficult points. Every group is to be published as soon as finished, irrespective of its position in the system and as a separate whole, with title and index. Upon the completion of each division, table of contents and index follow, as well as a general table and index when the whole work is finished. The various parts are to be sold separately. The work will be published in the German language; exceptionally, however, also in English, French or Latin.

It will be seen from the above that the German Zoological Society has in view a most ambitious and colossal undertaking, which, if it is ever brought to conclusion, must prove of inestimable value to zoological science. The plan seems well considered and the names of the contributors thus far secured promise well for the thoroughness of the work to be undertaken. But will it ever be finished? Or rather, will it be finished within such a period that the beginning will not be completely antiquated before the editor-in-chief writes *finis* on the last page of the last part? We all remember the fate of another German undertaking of vastly less ambitious dimension, viz.: Brown's 'Thierklassen,' which, although begun in 1859, is not yet completed, and anxiously ask whether it may not require more than

one generation to finish the 'Tierreich.' The prospectus does not even contain an estimate as to the aggregate number of volumes or signatures the whole may embrace, and the present reviewer has no means of furnishing such an estimate except for a limited branch. The first part, relating to birds, having been issued, it is possible to calculate the size of the portion relating to the class *Aves*, and to assert that, if the same plan is followed throughout, the birds alone will fill 10 large octavo volumes of about 600 pages each. The question then is, How many volumes are the other classes to occupy, and how many the insects alone?

The price cannot be considered high, in view of the character of the work. Regular subscribers who bind themselves to take all the parts published during the first five years will have to pay an average price of Mark 0.70 per signature, or about 18 cents, while the various parts will be sold separately at a rate about one third higher. On the above calculation the birds when concluded would cost about 65 dollars to subscribers and 87 dollars to others.

As stated above, the first part is now published and is before us.* It treats of the goatsuckers and swifts and is the work of Mr. Ernst Hartert, the director of the museum in Tring. If the rest of the work is going to keep up with the standard set by this beginning there can be no doubt that the undertaking will be a scientific success. But then, Mr. Hartert is not only exceptionally fitted for this work, but he has also had exceptional opportunities. Brought up with German thoroughness, he was transplanted to England, where, unfettered by national prejudices, he was free to select and develop the best sides of English methods. Five years ago he monographed these very families of birds for the catalogue of the British Museum, with the unrivaled material of that institution before him. He has thus had an opportunity to study specimens of nearly all the species he treats of, and his work thus partakes but little of the character of a compilation. The first part of the *Tierreich* is a condensed review, in German, of that monograph brought down to date. On the whole, the changes are few, showing how well the work was done from the start. 21 species and subspecies are recognized as having been added since 1892, while it has only been necessary to add or reinstate five species and subspecies described previous to 1892. On the other hand, only two or three species then recognized as such have now been reduced to subspecies. Two additional genera are recognized, viz.: *Cosmetornis*, reinstated, and *Nannochordeiles*, established in 1896. The changes in nomenclature are not many. The author has accounted for most of the changes in a separate paper published in the *Ibis* for 1896, to which those wishing further detailed information are referred. One important change in nomenclature, however, has not been noted there, as it was brought about by Dr. Reichenow only a short time ago. The latter found that Pallas has not established the genus *Apus* for *Monoculus apus*, Lin., as previously supposed, but that Scopoli, who proposed *Apus* for the Swift in 1777, had on a previous page established the genus *Apos* for the *Monoculus*. Of course, the latter is only a lapsus in transliterating ἀπους and is, in every sense of the word, a synonym of *Apus*, which must, therefore, be considered preoccupied. Reichenow considers the case parallel to that of *Picus* and *Pica*, names allowable under the codes of nomenclature, but there is absolutely no similarity between the cases. The latter generic appellations are distinct and separate Latin classical names for widely different birds, though the philological root of the two words is probably the same. But in *Apos* and *Apus* it is the same word, by some lapsus, or another, mutilated in the case of *Apos*. Were we to accept Reichenow's ruling we should have one species *Apos apus*, the monoculus, and another *Apus apus*, the bird, which would nearly nullify the idea of zoological nomenclature, viz.: to have a different name for each different species.

*Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Herausgegeben von der Deutschen Zoologischen Gesellschaft. Generalredakteur: Franz Eilhard Schulze.—1. Lieferung. Aves. Redakteur: A. Reichenow.—Podargidæ, Caprimulgidæ und Macropterygidæ bearbeitet von Ernst Hartert, Direktor des Zoologischen Museums in Tring (England). Mit 16 Abbildungen im Texte.—Berlin. Verlag von R. Friedländer und Sohn. 1897. 8vo. viii + 98 pp.

While we must thus congratulate the German Zoological Society upon the eminently satisfactory beginning of its enormous enterprise, and the zoological world at large upon the prospect of the assistance and stimulus which such a work must necessarily afford, we cannot forbear expressing the reservation that the promotors of the task when expecting that 'Das Tierreich' may become the foundation and starting point of all future systematic research ('Grundlage und Ausgangspunkt aller künftigen Systematik'). A work to become, in our days, the foundation and starting point of future systematic research must break new ground, open up new views and utilize new material to a much greater extent than it is possible in a general work of the scope of 'Das Tierreich,' with its necessarily excessive condensation and also necessarily uneven authority. No matter how prominent the monographers may be, it is conceivable that the work of many may fail to receive the universal acceptance which is essential to the fulfilment of the Society's fond hope. The time is not ripe yet for a new starting point. We are still in the midst of a period of development and upheaval. The natural relationships of animals are, to a great extent, obscure as yet, and the systematic arrangement in the work is bound to be greatly artificial in many groups at least. It is even to be feared that the very conciseness of the form and the consequent unavoidable preciseness of the statements, coupled with the superficial uniformity of the arrangement, may tempt the habitual generalizers, who are deficient in the special knowledge which 'Das Tierreich' is destined to be an expression for, into a belief that zoological science has reached a well-balanced uniformity which might make it safe to use the work as an undisputed authority in all branches upon which to build daring and glittering generalizations. For the working specialist, it is safe to say, no general work, however, well executed, will even supersede the Systema Naturæ of Linnæus as a starting point.

LEONHARD STEJNEGER.

A Study in Insect Parasitism: A Consideration of the Parasites of the White-marked Tussock Moth, with an account of their habits and interrelations, and with descriptions of new species. By L. O. HOWARD. U. S. Department of Agriculture, Division of Entomology, Technical Series (Bulletin) No. 5. [April] 1897.

One of the first insects which met the writer's eye on landing in New York in 1887 was the larva of the white-marked tussock moth (*Orgyia Hemerocampa leucostigma*). It is a beautiful creature, but destructive to the shade trees. It exhibits 'warning colors,' and is not eaten by the sparrows; so there is no telling how abundant it might become but for parasites and diseases.

Dr. L. O. Howard undertook a few years ago to study the life history and parasites of this insect, especially as observed in the City of Washington. One might have supposed that at this late date there was nothing new to be learned about so common a creature, but Dr. Howard knew better, and the present bulletin exhibits part of the new facts ascertained. It is not necessary to recount these facts, as the bulletin itself can be obtained without difficulty, but I should like to emphasize two or three points.

In the first place, we see that most admirable work may yet be done even in the very midst of our great cities, and that even new species may be obtained in tolerable abundance. Dr. Howard, in the present bulletin, records thirty-five parasites and hyperparasites of the *Orgyia*, of which no less than nine are described as new, all the new ones being from the District of Columbia. So even our business men, who have but a spare half-hour or twenty minutes at noon, can, if they are so inclined, gather a lot of *Orgyia* cocoons and breed parasites, with a fair chance of turning up actual novelties! Here, indeed, is an exciting and interesting pastime for young clerks and such persons whose city life is at present rather dull.

Secondly, we observe that when the various factors bearing upon the life of an insect are considered together, the interest of the subject is enormously increased. It is unfortunate that at least nine-tenths of the current literature of entomology relates either to dead specimens removed from their natural environment, or when referring to living insects takes an extremely narrow view of the subject. It results from this that one of the most fascinating

studies known, and one which yields abundant facts of philosophical interest, has the reputation in many quarters of being excessively dry and unprofitable. It may be laid down as a law that no one can take a really intelligent view of a group of insects while ignoring all those outside factors which influence its being and have made it what it is. Such a one may become skillful in determining species, but he is like a collector of coins, who should know perfectly every kind of coin which he possessed, but neither knows nor cares when or by whom the coins were made nor what the figures and inscriptions upon them meant.

Thirdly, it is perfectly clear that entomological works of the best kind can no longer be written by one man unaided. Dr. Howard could by no means have given us so satisfactory a treatise had he not been helped by his several assistants and investigators. Such help is gladly rendered by entomologists to one another, when it is known that it will be judiciously used and justly credited. It is a pleasure to assist such a man as Dr. Howard, and it is to be hoped that all who can cooperate usefully with him will make haste to do so. For while many of us cannot by ourselves write profitably on various subjects, we may together afford the materials, which, put together and added to by a competent person, will result in the production of an admirable treatise. Those who, like Dr. Howard, have shown that they can be trusted to use properly the materials or information supplied to them should receive strong support; while others (there are such) who persistently ignore field notes and biological data, or do not quote those data correctly, out of sheer carelessness, should not be supplied with material.

When the writer began to describe western hymenoptera he was solemnly warned that, not having access to the type specimens, he would be very likely to make synonyms. So far, he believes there are not more synonyms among his names than among an equal number of those proposed by Eastern entomologists—those detected on sending the types east are very few, but even if there were, he believes he would be justified, because he gives the exact conditions under which the insects were taken, while most of those described in the East are credited vaguely to 'Colo.', 'N. Mex.', etc., to the extreme vexation of one working on the fauna of this region. It is true, of course, that the material so described has been mostly sent in with inadequate labels, but the writer knows cases enough where the available data were not quoted; and certainly had any serious effort been made to get professional collectors to cite localities, etc., the information would have been forthcoming. This is shown by the fact that Mr. W. H. Edwards almost always manages to get excellent details. Compare Mr. Edwards' accounts of the butterflies taken by Bruce with the records of moths collected by the same entomologist but published by others. Compare also the different reports on the St. Vincent material collected by Mr. H. H. Smith.*

Several other matters might be touched upon. How interesting it is to read of the indirect influence of the sparrows on the *Orgyia*, of the fluctuation of the several insects from year to year, of the way in which the parasites abounded in different degrees in different parts of the city, and a dozen other things. The inadequacy of a bald record that one insect infests another is clearly brought out. Thus, while it is correct to say that *Apanteles hyphantriæ* and *Chalcis ovata* both infest the *Orgyia* and *Hyphantria*, they infest them in utterly different proportions.

There is little or nothing to criticise adversely. *Theronia fulvescens*, credited to Brullé, was, I believe, described by Cresson. On p. 52 it is said that the dipterous parasites apparently had no hyperparasites. But *Hemiteles townsendi* was surely such, as is duly indicated on p. 31.

The promptness of publication is very much to be commended. The Bulletin was trans-

* In the report on the Diptera, Tr. Ent. Soc. Lond., 1896, Professor Aldrich, reporting on the Dolichopodidæ and Phoridæ, gives the altitude, etc., while Professor Williston, reporting on the other families, generally fails to give any such data. It cannot be supposed that Mr. Smith carefully labelled two families of flies, and was quite careless about the rest! One of the individuals who worked up a group of the St. Vincent fauna (not flies) confessed to me that he threw away Smith's minute-locality labels.

mitted for publication on February 1st, and it comes to hand early in April. This is in great contrast with the delay which formerly used to occur.

T. D. A. COCKERELL.

MESILLA, N. M.

Marine Fossils from the Coal Measures of Arkansas. By JAMES PERRIN SMITH. (Preface by JOHN C. BRANNER, late State Geologist of Arkansas.) Pp. 72. Plates xvi.–xxiv.

This memoir, reprinted January 7, 1897, from the Proceedings of the *American Philosophical Society*, Vol. XXXV., No. 152, is also "the ninth of a series designed to illustrate the investigations and explorations of the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University." It was prepared at the request of Dr. Branner and deals with the rarer, and therefore more interesting, fossils of the Coal Measures. In these strata marine species furnish the most valuable data for the purposes of correlation. Heretofore they had been announced from but one locality: now, after a careful study of the material brought together by the last (Branner) survey, Professor Smith is able to announce them from twenty-one additional localities, extending from Independence county, on the east, to the Indian Territory, on the west. Forty-eight genera are represented by ninety species, of which forty-eight are found in the in the Lower Coal Measures and fifty-two in the Upper, ten species being common to both. The author characterizes the fauna as poor, such as would wander in whenever, by subsidence, the shallow waters became more habitable, and he also points out that, under the conditions then prevailing, it could not become well established, as it was frequently forced to migrate. In consequence of this, a gradual transition from the fauna of the Lower Carboniferous Limestone does not exist in this region. No attempt is made to classify the beds more minutely than into Upper and Lower Coal Measures, and even this is at times uncertain, especially when their marked similarity, folding and faulting are taken into consideration. Then follows a list of localities in which marine fossils were found, seventeen in the Lower Coal Measures and four in the Upper (one of which, Poteau mountain, is two miles west of the Scott county, Arkansas, line, in Indian Territory), together with the names of the fossils, character of the deposits, and the names of the collectors. A comparison is made with the Permo-Carboniferous of Kansas and Nebraska and the strong faunal resemblance of the Upper Coal Measures of Arkansas to the youngest Paleozoic rocks of Nebraska shown. The relations of the Arkansas deposits to those of Texas are also noted: "None of the characteristic ammonite genera [of the Permian] were found in the Arkansas region, but nearly every fossil found in these Coal Measures was also found in Texas. And in the Texas Permian nearly all the species excepting the ammonites were found in the underlying Upper Coal Measures. This makes the analogy between the Upper Coal Measures of the two regions very strong."

In view of this Professor Smith concludes "that while some of the beds in western Arkansas are very high up in the Coal Measures, none that belong above them are as yet certainly known, and the Poteau mountain syncline, across the line in Indian Territory, is the only place where there is any likelihood of finding Permian deposits." Some very interesting comparisons are also made with foreign faunas: for instance, of the Lo-ping fauna in China "nearly all of the species are either found in America, or they have their nearest relatives there." In this connection another point of unusual interest is brought out, viz., that many of the species which are "very common in America and Asia are unknown or rare in Europe, which fact would tend to prove a connection with Asia by water, and the separation of the European and the American Upper Coal Measure deposits by a land barrier." In short, our author regards the two regions, America and Asia, as belonging to the "same zoological province, the Pacific Carboniferous sea." Moreover, "many of the American species that are found at Lo-ping are also found in the Salt Range beds," thus extending the close relationship to India. Of the Upper Carboniferous fauna, at Itaitúba, Brazil, described by Derby, twelve out of twenty-seven species of brachiopods are shown to be "iden-

tical with American forms, although most of these are cosmopolitan." The *Strophalosia* of this locality by its close relation to Australian forms would indicate "a closer connection with the Australian, or Southern, Carboniferous region than with the Pacific Province."

But the classification and age of the Arkansas Coal Measures is the most difficult problem the author has to deal with and the most unsatisfactory, being at best provisional.. He says: "The Coal Measures of Arkansas have been temporarily classified by the Survey, for the sake of convenience, as Upper, or Productive, and Lower, or Barren Coal Measures. The division is not based on any paleontologic or stratigraphic break, but merely on the occurrence or non-occurrence of coal.

"The divisions that are recognized in Pennsylvania could not be recognized in Arkansas, but the strata of the two sections are correlated, as far as possible, with the scanty data now at hand.

"Of the age of the Lower Coal Measures we have only stratigraphic evidence, their position above the limestone of the Lower Carboniferous and below the coal-bearing beds of the Upper Coal Measure being unmistakable. But their known fauna and flora have been too limited and indecisive to enable us to correlate the stages with those of other Carboniferous areas, since collections have been made in but few places, and these chiefly in sandstones, where the preservation of fossils is usually unsatisfactory and the determination uncertain.

"But the Lower Coal Measures correspond in a general way to the Strawn and the lower part of the canyon division of Texas, to the Pottsville Conglomerate series, the Lower Productive Coal Measures, and part of the Lower Barren Coal Measures of Pennsylvania. The series corresponds, in the main, to the Middle Carboniferous limestone of eastern Russia."

Concerning the Upper Coal Measures of Arkansas, Professor Smith expresses the opinion that they "correspond to the upper part of the Canyon and the whole of the Cisco division of Texas." He infers, from the presence of certain fossils, that the beds of Poteau Mountain, I. T., are probably of the age of those in the Lo-ping district, and that the yellow shales of Scott county, Arkansas, are probably of the age of the Carboniferous Limestone at Moscow and the west slope of the Urals.

Under the heading, 'Paleobotanic Evidence,' reference is made to an unpublished report by Messrs. H. L. Fairchild and David White on the *Fossil Flora of the Coal Measures of Arkansas*, which "throws much new light on the stratigraphic and regional distribution of species, and has been of material aid in correlating the Arkansas strata with those of other regions." It may not be out of place here to express the hope that this monograph may soon be printed "They prove that all the Coal Measure plants* published from Arkansas belong to the horizon of the Upper or Productive Coal Measures." The position of the Van Buren plant bed is found to be below the marine beds of Poteau Mountain and above those occurring in the vicinity of Fort Smith, the last named horizon being above that from which most of the coal is obtained. While not entirely devoid of plant remains, the rocks of the Lower Coal Measures furnish but little evidence of a paleobotanical kind suitable for correlation purposes.

The Pacific Carboniferous sea is next discussed, including the following topics: Revolution in Devonian Time; The Carboniferous Sea; Upper Carboniferous in the West; The Pawhuski Limestone; The Interchange of Life between East and West (the most striking topic); Replacement of Limestone by Coal-bearing Formations in Western Europe; and Land Areas in the West. The Permian Pacific Ocean and the Triassic Pacific Ocean are also touched upon.

As to the time of the Ouachita Uplift Professor Smith writes: "The youngest rocks known to take part in the Ouachita Mountain system belong to the Upper Coal Measures, and the disturbance must have taken place at the border between the Carboniferous and the Permian. Still it is not unlikely that deposits of Permo-Carboniferous age may yet be found at some places in that region. * * *

"This uplift may be of the same age as that movement in the Appalachians which cut off the Upper Barren Coal Measures of Pennsyl-

*Exclusive of those described from Washington county.

vania and West Virginia entirely from the western sea ; in these deposits no marine fossils are found, but only land plants and fresh-water Crustaceans and a few fresh-water mollusks."

A table showing the correlation of the Coal Measures of Arkansas and similar deposits in Indian Territory, Texas, the Mississippi Valley, Pennsylvania, China and other parts of Asia, Russia and the Ural Mountains, India and South America, closes what may be termed the first part of this contribution. The remainder, pages 25–72, consists of an annotated list of the Marine Fossils of the Arkansas Coal Measures, together with a check list showing their stratigraphic distribution and the localities of their occurrence in Arkansas and elsewhere. Nine excellent plates accompany the text. A new species of *Gastrioceras*, *G. branneri*, and a variety of *Pronorites cyclobolus*, Phillips, called *arkansiensis*, are described. A description of the trilobite *Phillipsia* (*griffithides*) *ornatea*, by Capt. A. W. Vogdes, U. S. A., quoted from the Proceedings of the California Academy of Science,* is also inserted.

By those interested in the organic side of geology Professor Smith's paper will be read with much satisfaction. The comparative study of faunas, their relations and distribution, is a line of investigation which promises much in the near future.

FREDERIC W. SIMONDS.

UNIVERSITY OF TEXAS.

Clay Deposits of Missouri. By H. A. WHEELER. Missouri Geological Survey, Vol. XI., 622 pp., 39 pl. Jefferson City, 1896.

The recent report upon the Missouri clays, while essentially economic in character, discusses a number of problems of wide scientific interest. Among these the nature of plasticity as exemplified in clays is perhaps the most important. Professor Wheeler finds, as a result of physical tests and the microscopic examinations of Haworth, that the fine plate theory of Johnson and Blake † is the only one which satisfactorily explains the facts, and that fineness in itself has no real bearing on the plasticity.

It is found that the fusibility of a clay is a function not only of the chemical composition, but of the fineness of grain and the density. The following formula is developed and thought to be satisfactory for approximate results, but it is held that absolute results can only be obtained by testing.

$$FF = \frac{N}{D + D' + C}$$

In this FF represents the numerical value of refractoriness. N represents the sum of the non-detrimental constituents, or the total silica, alumina, titanic acid, water, moisture and carbonic acid. D represents the sum of the fluxing impurities or the alkalies, oxide of iron, lime and magnesia. D' represents the sum of the alkalies, which are estimated to have double the fluxing value of the other detrimentals, and hence are added twice. C has the following values:

$C=1$,	clay	coarse	grained	sp.	gr.	over	2.00
$C=2$,	"	"	"	"	"	2.00 — 2.25	
$C=3$,	"	"	"	"	"	1.75 — 2.00	
$C=2$,	"	fine	"	"	"	over	2.25
$C=3$,	"	"	"	"	"	2.00 — 2.25	
$C=4$,	"	"	"	"	"	1.75 — 2.25	

There are a large number of physical tests, chemical analyses and detailed descriptions of processes, and the work is one of wide interest and considerable value.

H. FOSTER BAIN.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, MAY.

On Urethanes: By O. FOLIN. When sodium methylate is treated with acetbromamide the yield is not, as might be expected, a hydroxylamine derivative, but a urethane which is formed by a molecular rearrangement during the course of the reaction. The purpose of the author was to test this reaction, to find out if it was general and also the effect of different negative and positive groups substituted in the bromamide. As a result of a number of experiments with different radicals, it was found that the difference in the nature of the radical did not affect the reaction, which is a general one that can be used in the preparation of urethanes. The urethanes when treated with phosphorus penta-

* Second Series, Vol. IV.; p. 589 *et seq.*

† *Am. Jour. Sci.* (2), XLIII., p. 357. 1867.

chloride yield chlorformanilides, thus offering a simple and easy method for preparing these substances. When free urethane is treated with phosphorus pentachloride a more complex reaction takes place, a carbamide chloride being formed. When urethane and phosgene are brought together, three different reactions take place, depending to some extent upon the relative amounts of the substances present.

Action of Phosphorus Pentachloride on Aniline and its Salts: By J. ELLIOTT GILPIN. The author has obtained several products by the substitution of one or more chlorine atoms of the phosphorus pentachloride by residues of aniline. When aniline hydrochloride and phosphorus pentachloride are heated together a volatile compound having the composition $PCl_3 (NC_6H_5)$ is formed. This is unstable and readily decomposed by water. A product, obtained by treating the aniline with phosphorus pentachloride, $PCl (NHc_6H_5)_4$ is, on the other hand, extremely stable, resisting, in general, all except the most energetic reagents. Derivatives of this substance cannot be obtained readily, if at all, as it is completely decomposed if any action takes place. When heated it forms a black substance, containing probably carbon and phosphorus, which is remarkable for its stability. Compounds analogous to the one formed from aniline can be obtained from the toluidenes.

On the Preparation of Metabrombenzoic Acid and of Metabromnitrobenzene: By H. L. WHEELER and B. W. MCFARLAND. The most general method that has been used for the preparation of these compounds consisted in heating the benzene compound with bromine or ferrous bromide in a sealed tube for several days. The authors find that the reactions can be performed in an open vessel and in a short time by using iron as a bromine carrier. This is even better than already prepared ferrous bromide. The substance is warmed with iron wire, and bromine is added slowly until the action is complete. The method was tested in a number of cases and proved to be one of general applicability.

On the Non-existence of Four Methenylphenylparatolylamidenes: By H. L. WHEELER. In an article published recently Walther describes the preparation of this substance by four different methods. Each method, according to him, gives a new amidine, and he supposes them to be isomers. The author of this paper has repeated the work, as the results obtained by Walther are not in harmony with the generally accepted behavior of amidines, and finds that the products obtained by the first and second methods are mixtures, while the third and fourth methods yield one and the same product, thus showing that instead of four only one amidine was obtained.

South American Petroleum: By C. F. MABERY and A. S. KITTELBERGER. In the present paper Professor Mabery contributes further results obtained in his investigations on petroleum. This oil was obtained in South America and differs in some ways very much from the product obtained in this country. The methods hitherto used for isolating the products failed in some cases, and the exact nature of the products could not be determined. The investigation showed, however, that the hydrocarbons present consisted of a series containing less hydrogen than $C_n H_{2n+2}$ and more than $C_n H_{2n-6}$ with perhaps a trace of these.

The Action of Certain Alcohols on Asymmetadiazoxylenesulphonic Acid: By W. B. SHOBER and H. E. KIEFER. The action of this diazo compound with methyl, ethyl and propyl alcohols was studied, and in each case two amides, one the xylenesulphon amide, and the other the amide of the xylenesulphonic acid of the alcohol, were obtained, whether the reaction was carried on at ordinary temperatures or under pressure. The methoxyxylenesulphonic acid and its salts were made and studied, as were also these of the propyl acid. By the oxidation of Asymmetamethoxyxylenesulphonamide they obtained methoxysulphaminetolnic acid and from it prepared its salts.

The Action of Ethylic Oxalata on Camphor: By J. B. TINGLE. Several structural formulæ have been assigned to camphor, and in all of these the presence of the group CH_2 CO is recognized. In the study of the related bodies, the diketones and keto-acids, the compounds chiefly investigated have contained strongly negative groups; but in the present investigation the author has used substances only feeble in this respect, in hopes of throwing some light on this class of

bodies. The results obtained, however, do not warrant any strong assumptions either way. He prepared ethylic camphoroxalate and the free acid, and from a study of their behavior as compared with the compounds studied by others he drew some conclusions as to their probable structure.

Preparation of Zinc Ethyl: By A. LACHMAN. The author has improved the method for the preparation of zinc alkyls, in which the copper-zinc couple is used. The difficulties met with in working according to the former directions are avoided by mixing zinc dust and copper oxide and heating in a glass tube in a current of hydrogen. In this way an excellent alloy is obtained. Some suggestions are given as to the preservation and use of the zinc alkyl.

A Simple Test for the Halogens in Organic Halides: By J. H. KASTLE and W. A. BEATTY. The authors have devised a simple method of testing for the presence of the halogens in organic compounds. The substance, if not volatile, is heated with a mixture of silver and copper nitrates. The product is treated with dilute sulphuric acid and zinc, to reduce any halogen compound of silver, then filtered and tested with silver nitrate. If the substance is volatile it is heated in an S-shaped tube, the nitrates being placed in the bend beyond the substance and the two heated alternately, so that the volatile substance is distilled into the nitrates. The method was found applicable to all classes of compounds.

The following books are reviewed in this number of the *Journal*: Commercial Organic Analysis, A. H. Allen, Vol. III., Pt. III.; Engineering Chemistry, T. B. Stillman; Ptomaïns, Leucomaïns, Toxins and Antitoxins, V. C. Vaughan; A Laboratory Manual of Inorganic Chemistry, R. P. Williams; Laboratory Calculations and Specific Gravity Tables, J. S. Adriance.

J. ELLIOTT GILPIN.

THE AMERICAN GEOLOGIST, MAY.

'CHANGES of Level in the Bermuda Islands,' by Ralph S. Tarr. The conclusions of previous observers are reviewed and some new facts presented. The results, as based upon all the investigations yet made, show that the Bermudas are underlain by a base rock of shell and coral fragments formed by wave action. This shell sand beach was then consolidated into a dense limestone and suffered some aërial erosion, and was finally depressed and attacked by the waves. In the last stage it was partly covered by beach deposits of pebbles and shells. Then came an uplift of 40 or 50 feet during which land shells lived on the beach deposits. Accumulations of blown sand were made and the outline of the Bermuda hills perfected by the action of the winds. Since then there has been a depression causing much land to disappear and the outline of the area to become very irregular.

James P. Kimball completes his examination of the 'Physiographic Geology of the Puget Sound Basin.' It describes the following chief historic events. The deposition of the Tejon strata of the Eocene, their subsequent disturbance, followed by denudation, reaching base-level during the glacial period. Glacial drift was accumulated in the axial part of the basin. Later alternations of level brought about fluvial erosion of the drift mantle, then submergence below sea level flooded the lower valleys, producing the present type of inlets and sounds. In recent times partial emergence has taken place.

E. W. Claypole describes a large Dinichthys, considered as belonging to a new species.

'On the Genesis of Clay Stones,' by H. W. Nichols. Claystones are regarded as crystalline aggregates whose growth has been modified by the large amount of foreign matter (clay) present, and the conditions of their formation are the same as those which would, in more favorable positions, lead to the formation of an aggregate of calcite crystals of the more usual form. There are two conditions which appear favorable to the formation of concretions: (1) the presence of arragonite with the disseminated calcite of the clay beds, and (2) the presence of unstable humus acids. The more soluble arragonite continuously goes into solution, thereby over-saturating it with respect to calcite, upon the particles of which the calcium carbonate of the solution is deposited. Thus the calcite grows as the arragonite diminishes.

'Nomenclature of the Galena and Maquoketa

Series,' by F. W. Sardeson. A supplementary discussion to the papers by the same author on these formations, showing the confusion arising from a shifting nomenclature.

N. H. Winchell gives a partial bibliography with notes on 'The Age of the Great Lakes of North America.' It is interesting to have the various opinions thus summarized for reference. The prevailing belief has been that these lakes occupy preglacial valleys which have been shut off by earth movements and by glacial accumulations.

Warren Upham discusses the 'Relation of the Lafayette or Ozarkian Uplift of North America to Glaciation.' Both are referred to the Quaternary.

SOCIETIES AND ACADEMIES.

THE 95TH REGULAR MEETING OF THE CHEMICAL SOCIETY OF WASHINGTON, APRIL 8, 1897.

The first paper, 'Three Early American Chemical Societies,' was read by Dr. H. Carrington Bolton.

The first Chemical Society ever organized in either hemisphere was founded at Philadelphia in 1772, forty-nine years before the Chemical Society of London, the oldest in Europe. The President was Dr. James Woodhouse, professor of chemistry in the medical department of the University of Pennsylvania, and the first Vice-President was Felix Pascalis Ouvrière, a naturalist born in France and sometime a resident of Santo Domingo. On December 10, 1801, Robert Hare presented to the Chemical Society of Philadelphia his memorable paper on the 'Hydrostatic Blow-pipe,' which was published by the Society in the following year as a pamphlet with the title: 'Memoir on the Supply and Application of the Blow-pipe.'

In 1811 a second Chemical Society was founded in Philadelphia called the 'Columbian,' under the presidency of Professor James Cutbush. The constitution of this Society provided for levying fines on absent members and those who refused to accept office when elected. The Society numbered sixty-nine members, of which thirty-one were foreign chemists, and thirteen junior members; these included the most prominent chemists and philosophers living on both sides of the Atlantic. In 1815 The Columbian Chemical Society of Philadelphia published one volume of memoirs; this contained twenty-six essays on a variety of topics original, speculative and practical.

The third Chemical Society was the Delaware Chemical and Geological Society, organized at Delhi, New York, in 1821; it was, however, short lived and issued no publications.

Dr. Bolton's essay contained brief biographical sketches of the prominent members of these early Societies.

The second paper, on 'The Experimental Determination of the Hydrothermal Value of a Bomb Calorimeter,' was read by H. W. Wiley and W. D. Bigelow. The methods previously suggested by other authors for this purpose were reviewed and their advantages and disadvantages discussed. The authors employed a relatively large body of warm water, instead of a very small portion, as had previously been used. Two Beckmann thermometers were employed, which made it possible to read a temperature to a thousandth of a degree, so that the error which would otherwise arise from the slight change of temperature was overcome by the accuracy in reading.

The last paper, on 'The Influence of Vegetable Mold on the Nitrogenous Content of Oats,' was read by Dr. Wiley. Attention having been called several years ago to the large increase in the nitrogen in sugar cane grown in the muck soils of Florida, an investigation was instituted by the Department of Agriculture, in 1894, to determine in what way the humus of such soils influenced the nitrogen contents of cereal crops. The first year's investigation was preliminary, but it showed distinctly that oats grown on soils rich in vegetable mold contained a larger percentage of nitrogen than that grown in other soils. The total increase is, in general, about 25%. This was not in the grain alone, but also in the straw. The second year's investigation verified this result. The increase was largely in amid nitrogen, the percentage of proteids not being greatly increased. The results are, therefore, not so interesting from an economic point of view. When it is remembered that these vegetable soils are extremely rich in nitrogen,

and when it is further considered that they are quite deficient in nitrifying organisms, it is fair to conclude that at least a portion of this excess of nitrogen which they contain is assimilated directly from the vegetable mold without previous oxidation to nitric acid. Data was adduced which showed that the addition of phosphatic fertilizers tended to diminish the actual percentage of nitrogen in the crop harvested.

At the end of the regular program Professor Warder exhibited some photographs which showed the power of various chemical substances to absorb X-rays, and explained the technique of the manipulation.

V. K. CHESNUT,
Secretary.

ENTOMOLOGICAL SOCIETY OF WASHINGTON, MAY 13, 1897.

THE President announced the death, on May 3d, of Martin L. Linell, an active member of the Society.

Mr. B. E. Fernow referred to the recent increase of pin holes in timber from the Southern States, caused either by some Ptinid beetle or a Scolytid, and discussed the possibility of preventing damage by some system of timber management.

Dr. E. F. Smith showed Beijerinck's recently published paper on the 'Cecidiogenesis and alternation of genera of *Cynips calicis*,' and briefly reviewed the work.

Mr. Schwarz exhibited specimens of the Meloid beetle, *Phodaga alticeps* Lec., and read a letter from Mr. Hubbard detailing the habits of this insect.

Mr. Schwarz presented a paper entitled 'Two genera of beetles new to the United States.' The genera are *Cylidrella*, family Trogositidæ, discovered by Mr. H. G. Hubbard at Yuma, Arizona, preying upon a Scolytid in Parkinsonia wood, this genus having been founded by Dr. Sharp upon a single species, *C. mollis*, found by Mr. Champion in Guatemala; and *Latheticus*, family Tenebrionidæ, found by Mr. Hubbard under Mesquite bark at Indio, in the Colorado desert of California, the only other species of this genus, *L. oryzæ* Waterhouse, having been found in rice brought to England from India.

Mr. Banks presented a paper entitled 'Three new lace-winged flies,' in which the following species were described: *Chrysopa sabulosa*, *C. Fraterna* and *Leucochrysa americana*.

Mr. Howard presented a communication on 'An interesting wax insect from California.'

Mr. Ashmead presented a paper entitled 'The genera of the Encyrtinæ,' which reviewed the history of the subfamily and included a table of the known genera, to which he had added nine.

L. O. H.

ANTHROPOLOGICAL SOCIETY.

THE 264th regular meeting of the Anthropological Society was held Tuesday, May 4, 1897. Dr. George M. Kober read a paper entitled 'Progress and Achievements in Hygiene,' in which he gave a résumé of the various attempts to introduce sanitary measures, either general or specific, in various countries at divers times, and noted the good results which followed, many of them being permanent in character.

The marked immunity of the Jews was noted, and how it had continued even to the present day, as evidenced by the extremely low mortality; this condition of affairs was attributed not so much, to rigid enforcement of the laws of health prescribed by the Hebraic law as to their racial sobriety producing of a sturdy constitution, capable of resisting disease to a considerable degree. The author then recited incidents tending to prove the assertion that the desire to prevent diseases was innate in the human race. The relation of medicine and religion, the medicine dance, the disposal of the dead, cremation and other forms of primitive practices were given in detail.

A 'General Discussion upon Sanitation among Primitive Peoples' then followed. Mr. Geo. R. Stetson said that in equatorial Africa there was an absence of filth in persons and places, and spoke of the misconception concerning the climatic and physical conditions of Africa. The endemic and introduced diseases were then noted. The general discussion was then taken up by Professor L. F. Ward, Drs. McGee, Woodward, Magruder and McCormick.

J. H. MCCORMICK,
General Secretary.